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Volumes V and VI

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The Journal of the Biological Photographic Association

EDITORIAL

The Convention at Boston, September 24, 25, and 26

The program for the 1936 Convention, which is being held at the Hotel Lenox in Boston, September 24–25–26, is nearly complete. This year more time is to be allowed for the discussion of papers. A discussion period will follow immediately after each paper has been read, so that the material will be fresh, and no questions will be forgotten due to a lapse of time. Among the papers to be read are the following:

"Blood Photomicrography." Miss Stella Zimmer, Syracuse University.

"Motion Pictures as an Aid in Teaching Entomology." Dr. C. T. Brues, Harvard University.

"Print Quality." Mr. Ralph Creer, U. S. Veterans Administration, Hines, Ill.

"Ultra Slow Motion Pictures with the Mercuric Spark Apparatus." Dr. Edgerton, Mass. Institute of Technology.

"Improved Illuminating Systems for Photomicrography with Oil Immersion Lens." Mr. Jean Kieffer, State Sanatorium, Norwich, Conn.

"Direct Duplicating Film." Agfa Ansco Corp., Binghamton, N. Y

"Ortho-Stereoscopic Photography." Mr. Henry F. Kurty, Scientific Bureau, Bausch and Lomb Optical Co., Rochester, N. Y.

"Further Experimental Contributions to the Field of Infra Red Photography." Mr. Leo Massopust, Marquette University, Wisconsin.

"Applications of 35 mm. Kodachrome Film to Biological Photography." Dr. C. E. Kenneth Mees, V.-Pres. in charge of research and development, Eastman Kodak Company, Rochester, N. Y.

"Surgical Motion Pictures with 16 mm. Kodachrome A Film." Harris B. Tuttle, Rochester, N. Y.

"Three Dimensional Motion Pictures." Land-Wheelwright Co., Boston.

This last is something new, which has not yet been released to the general public. The results are marvelous. Mr. Wheelwright will show a surgical film made by this process. It is hoped that it will be in color. The writer has seen several so-called stereoscopic motion pictures, but has never seen anything which could be remotely compared with this new process. We are indeed fortunate to be able to present this paper at the Convention. The Boston Chapter previewed this method in July and the members were most enthusiastic. Do not miss it or you will surely regret it.

The papers by Dr. Mees and Mr. Tuttle will bring to the attention of the members some of the most recent developments in color photography. Dr. Mees is a world-wide authority on color photography, and it will be our good fortune to have him at this meeting unless something untoward occurs to prevent his attending.

There are several other papers to be presented, which are in the course of preparation, but the details are not available at this time. The Boston Y. M. C. U. Camera Club has most kindly thrown open its rooms to the members attending the Convention, and it is hoped that members will avail themselves of the privilege. The Y. M. C. U. Camera Club is in the building of the Boston Young Men's Christian Union at 48 Boylston St. and is one of the oldest and most active camera clubs in the country.

It is hoped that a large number of Association members will attend the Convention. The program has been worked up by the entire Boston Chapter under the direction of an Executive Committee for the Convention. Come to the Convention and enjoy the hospitality of the "Land of the Bean and the Home of the Cod." A hearty welcome for each and every one is assured. See you in Boston!

F. R. HARDING,
Chairman on the Arrangement
of Convention Affairs

BIOLOGICAL PHOTOGRAPHIC ILLUSTRATION*†

J. S. NICHOLAS

New Haven, Connecticut

I. INTRODUCTION

The main purpose of the photography of biological subjects is always the ultimate illustration of the material presented. This may be simply for the purpose of record from which the word picture is later formed by analysis, or it may be for the added accentuation of a description which is later to appear on the printed page.

Many of us who are amateurishly inclined to photography are compelled to work with our biological materials en masse. We photograph everything as a matter of record and later select those few photographs which best illustrate the points under discussion. This process is akin to that of the motion picture addict except that he realizes at the outset that cuts and splices are going to be necessary in the compilation of the finished film. He expects a definite wastage and allows for it. The photographing scientist rarely considers the wastage factor, and this results in a plethora of illustrations to scientific articles which the weary editor returns to the injured author with a frank but cutting request.

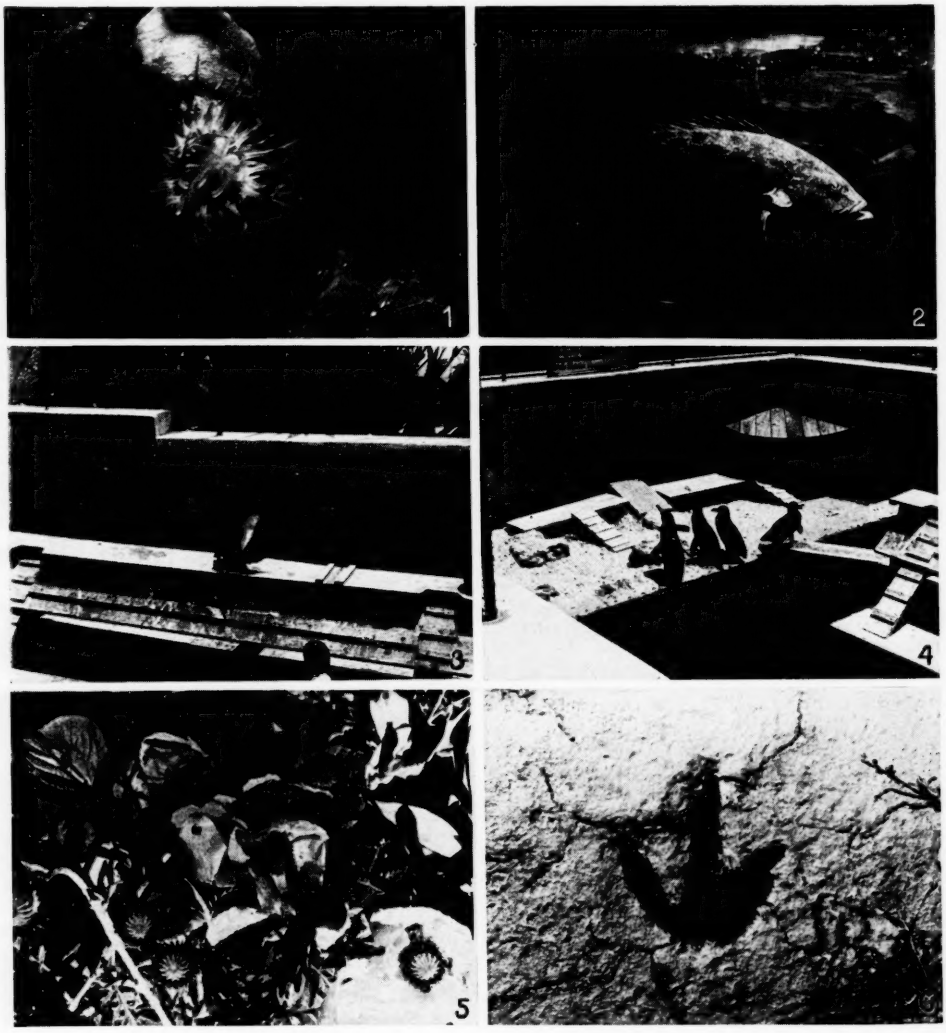
Unfortunately the editor is seldom in position to analyze the scientific applicability of the illustrations submitted, even though he might be qualified to estimate their photographic excellence. The more pertinent illustrations may not be perfect photographically, for the biologist frequently must take his material as he finds it. The use of flood lights and special apparatus is impossible in a great many instances. The object is the important thing, not the complexity of arrangement. Under such conditions the negative may not only show a flat image, but the high lights and background leave much to be desired. Yet unless one is willing to accept such conditions, much biological material is lost completely. It is better to have the record, even though it be a poor one, than no record at all.

II. GENERAL PHOTOGRAPHY

While not all records need publication, the end result of a biological photograph is a "still." Four instances of this type of work are shown

*From the Osborn Zoological Laboratory, Yale University.
†Received for publication April 28, 1936.

below. Figures 1 and 2 were taken in the Bermuda aquarium with natural lighting from outside. The exposure was much less than normal



FIGS. 1–6

($\frac{1}{25}$ second, f: 2.8 Contax), and produced a very flat negative on Panatomic film. The water of the large aquarium tank served as a natural blue-green filter as did also the heavy plate glass forming the anterior

viewing surface. These two factors assisted in definition, but lengthened the time factor. Since in both cases there was considerable motion, the time factor, $\frac{1}{25}$ of a second, was long in relation to the moving object. Figures 3 and 4 show the photographic effect obtained under very trying illumination. Penguins are always interesting and move with apparent slowness, but also with a queer jerk which frequently blurs the film. The dazzle of the full Bermuda midday sun reflected from the concrete wall, and the water surface necessitated minimal time of exposure, while the closeness of the operator to the object rendered imperative the use of a small aperture. Using $\frac{1}{500}$ of a second at f: 16 on Panatomic film gave a fair amount of contrast and prevented the glare which was expected under the conditions. This serves to illustrate what is meant by producing a record of biological significance with the accent on taking the picture under natural conditions and developing for future use.

Fortunately for most of us the outdoor variables are by no means the only things with which we have to work, as evidenced in figures 5 and 6, where the objects were not in motion and where lighting conditions were favorable. Figure 5 is a study of the poppy at the time of fullest petal extension to show the relation of the stamens and pistil. Figure 6 reproduces the footprint of a small Connecticut valley dinosaur taken in the field. The texture of the rock, the cracks of sedimentation, and the twigs at the side for contrast with the footprint, all show the effect obtainable with a fixed object.

III. LABORATORY PHOTOGRAPHY

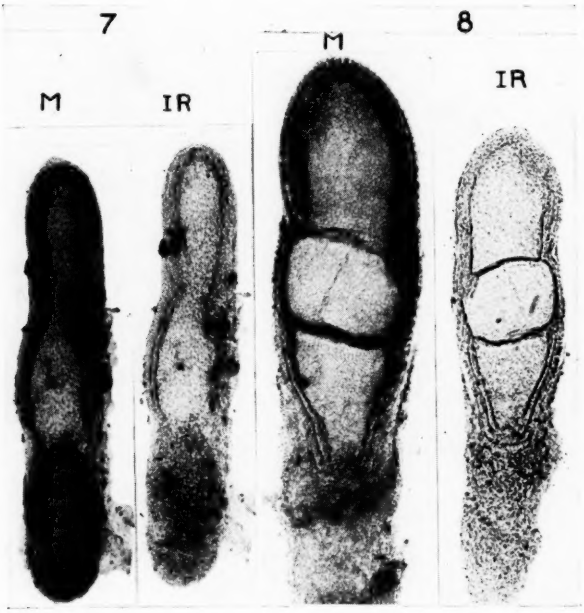
The use of controlled lighting with animals either temporarily or permanently immobilized offers a greater field for intensive photographic study. Some examples of this are adequately and completely shown in Heuser and Streeter's paper on early pig embryology (Carnegie Inst. Pub. XX). A description of their apparatus appeared in this Journal (vol. II, pp. 89–91, 1933).

In the author's own work on the embryology of the rat, many small points which have been known to professional photographers for many years have had to be reworked, in an attempt to reproduce photographically the conditions found in the animal.

IV. CHOICE OF PLATES

It is of course a recognized fact that better average results are obtained in a piece of work if the plate or film is standard. Most of the work in

this laboratory is done on Orthonon plates. However, when this was tried with the embryonic material it was found that the variation in the density of the embryo gave inconstant results on the plate. The most useful general purpose plate for this particular series is one which is seldom used for general work. This is partly due to its name, *Metallographic*, which makes one think that its use is restricted to metallurgy or engineering. For biological photography this plate is superior to the Orthonon and compares very favorably with the process panchromatic.



FIGS. 7–8

The normal contrast of the structures in the embryo was intensified by the use of a slight staining with Delafield's haematoxylin, just sufficient to give a grayish tinge to the embryo. In cleared specimens this served as an auxiliary filter and enabled one to use much less time for exposure as compared with the rather heavy blue color filters. This procedure was used in connection with a No. 22 Eastman filter.

Infra-red plates (Type IR) with Eastman filter No. 87 were employed with considerable success. Since the vogue for ultra-violet and infra-

red photography has had such a general consideration in the biological field, it may be well to give the author's own experience with them. For macroscopic objects similar to the ones under consideration, ultra-violet photography has little to add except in bizarre effect. It adds nothing to what may be obtained in routine work and in general detracts by giving unusual pictures which are subject to interpretation only in the retrospect of what we have revealed in the intermediate spectrum. The increased definition secured by Lucas which is so remarkable in optical layers or sections is not the main objective in the author's preparations (Bell Telephone System, 1930, B-514. Technical publ.).

FIG. 9

Infra-red plates have distinct uses in biological photography. These are limited, however, in scope and can easily be over-emphasized. All the soft effects which tend to give us an adequate impression of a total embryo may be lost in the infra-red range. There is a tendency to flatten the image since all thicknesses and all contours are reduced to silhouette.

In the particular case under consideration the infra-red is most applicable to the early embryos (stages 11 and 12) shown in figures 7 and 8.

The left figure in each case is the metallographic, the right the infra-red. Figures 7 (M and IR.) are taken on exactly the same level of focus, the outlines are sharper, the depth and definition are greater with infra-red, magnification is the same. The two remaining figures on this plate are of the same embryo but taken at a different angle and a different magnification. In the first instance the infra-red has a distinct advantage over the metallographic. These embryos were circa 1.25 mm. in length and 0.3 mm. in diameter. The third embryo was 1.8 mm. in length and 0.5 mm. in diameter. In this case the actual embryonic structures show to much better advantage in the metallographic plate. The result with infra-red is not what an investigator really sees. Moreover, it gives a total misconception of the curvature of the cylinder. The same result is obtained in figure 9. In each case the infra-red photograph has lost the requisite detail necessary for an adequate interpretation of the embryonic structures.

Infra-red has its use, however, in embryonic illustration with larger animals. The 10 mm. (stage 36), 15 mm. (stage 37), and the 25–30 mm. animals can be photographed for internal structure only in this way. This gives better results than X-ray, showing structures in silhouette to a much greater depth and in much better perspective (fig. 10).

V. CAMERA EQUIPMENT AND ACCESSORY APPARATUS

As everyone knows, the camera equipment and accessories can be as complicated as the worker wishes. For the present work a Bausch and Lomb Type H camera was used with 32, 48 and 72 mm. lenses, depending upon the size of the specimen. Since all figures except 12 and 13 were taken with transmitted light, the embryos were placed on a small dissecting microscope and transilluminated by an arc light. The equipment was made as simple as possible; all complex manipulations were limited to the embryo and not lavished upon the apparatus.

In each case, the exposure time was worked with minimum lens aperture—an absolute necessity if the detail is to be secured in thick specimens.

VI. METHOD OF LIGHTING

Any convenient light source can be used, preferably artificial, although this is not necessary. The variation of natural lighting renders it extremely difficult to reproduce photographs, particularly when intensity makes so much difference. Most of the rat-embryo photography has

been performed with the transillumination of the animal after clearing. The effect of this is to give a pictorial correlation between the external morphology of the organism and its internal development (fig. 11). In

FIG. 10

some cases the structures are so clearly delineated that no word description is required. This, of course, is the ultimate aim of illustration.

In the above procedure the process of preservation and subsequent

FIG. 11

FIG. 12

treatment must be done carefully with the idea of producing the greatest degree of translucency as well as maintaining a fair degree of contrast. Preservation must be thorough and within limits; any of the recognized fixing fluids will work. Zenker, corrosive sublimate and Bouin all gave favorable results. Petrunkevitch's paranitrophenol gave exceptional results in most stages used. Formalin did not. Subsequent to fixation, the embryos were thoroughly dehydrated and then cleared in methyl salicylate (synthetic oil of wintergreen). Before dehydration they were lightly stained in Delafield's haematoxylin. The animals were photographed either in alcohol (opaque), or in oil of wintergreen (cleared).

When the embryos were photographed by reflected light, illumination was secured by using two Bausch and Lomb adjustable microscope lamps (ribbon filament) placed at equal distances on either side of the upright camera so that illumination was oblique across the embryos from the upper left to the lower right of the plate. Black velvet was used for a background, eliminating completely the question of shadows. Figure 12 shows the amount of surface detail obtainable by this method. Compare figure 11 which shows the result obtainable by transmitted light with figure 12.

VII. CHOOSING THE BACKGROUND

In much work, particularly in photomicrography, unevenness of background detracts from the objects shown. This is particularly true in laboratories which do not have a photographic technician; in this case the investigator centers his attention only upon the section and is apt to overlook the factors detracting from his figure. The background can be corrected either on the plate by the application of opaque, or on the print by painting the parts to be removed (on a dry print) with potassium ferricyanide and then immersing in standard hypo with subsequent washing.

Most investigators feel that a background is unchangeable and some of us find that one certain animal with the wrong kind of backgrounds exhibits certain things which are necessary for illustration. When this situation arises, the background can be reversed from its original condition. The manipulation requires care but can be handled adequately by any one. Figure 13 illustrates this point. The embryo pictured on the left is not suitable as a good illustration. The background is obviously imperfect. Bubbles appear in the medium and one structure,

the heart, does not appear in the picture. The figure on the right is made from the same plate after masking. A print was made on Ad Type paper, the outlines of the image were cut with a razor blade, and the mask fastened to the photographic plate on the side away from the emulsion.

The reverse of this operation is more difficult and consists of either chemically (Farmer's reducer) or mechanically clearing the emulsion around the image desired. A sloppy background is inexcusable in the

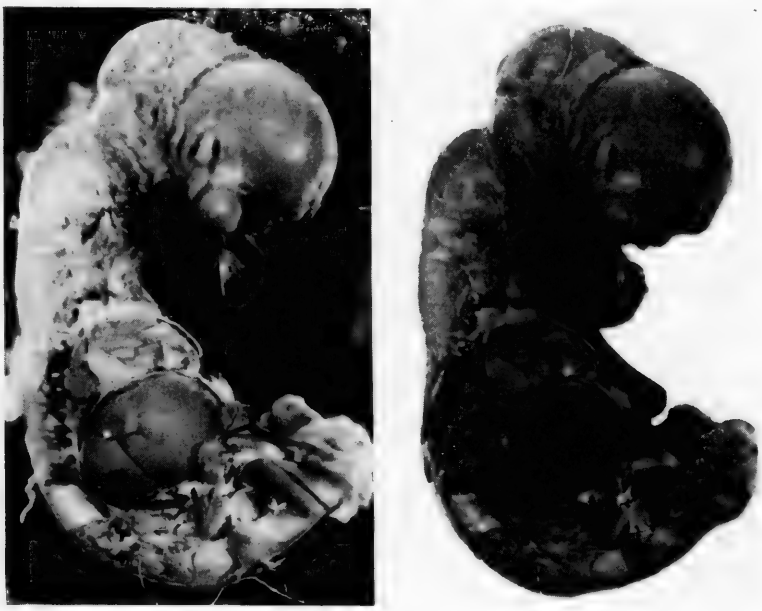


FIG. 13

finished print. Care in planning the original set-up and background can generally take care of all but the unexpected contingencies. When these occur, however, it is a great relief to amateurs to know that mistakes can be corrected and that the end result can be made a representative illustration.

SUMMARY

1. The photography of biological materials is an absolute requisite for the purpose of record as well as subsequent illustration. This applies

under outdoor variable conditions as well as in controlled laboratory set-ups.

2. The importance of choosing plates has emphasized the possibility of using the metallographic plate for routine work. In the particular set of problems, prestaining gross specimens served to intensify the contrasts between tissues and organs.

3. The use of infra-red photography has been sharply delimited in the material under discussion. In many cases this method cannot be successfully employed. When judiciously used it can do wonders in portraying silhouetted detail in fairly large and rather opaque objects.

4. Complex laboratory equipment is not a prerequisite for adequate illustrative photography. Attention must be given to preliminary treatment of the material and subsequent treatment of the image on the plate with particular reference to background.

5. The background originally chosen may be altered or reversed in order to avoid unsightly spots or to render the illustrative material uniform.

PHOTOGRAPHY OF THE CERVIX UTERI*

J. M. BRUNER, L. E. ROSEBROOK AND G. W. CUSHMAN

Des Moines, Iowa

Photography of the cervix is of value in presenting the true appearance of the normal and pathological cervix for the illustration of scientific articles and textbooks. This has previously been done only by drawings. It also makes possible a true record of the cervix before and after cauterization, plastic operations or radium application.

The chief problems are those of adequate exposure of the cervix and effective lighting. The ordinary bivalve vaginal speculum is not satisfactory. It fails to give good exposure due to the redundancy of the vaginal walls which tend to infringe on the photographic field. It is also unsuitable because of the variable position of the cervix and the incon-

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Editor's Note: The reader is also referred to the article, *Photography of the Cervix Uteri*, by Ralph P. Creer, of Hines, Ill., in the December 1935 issue of THE JOURNAL OF THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION. Vol. IV, No. 2.

* Received for publication May 16, 1936.

stant depth of the vagina. As to lighting, when the cervix is illuminated by flood lights outside the speculum (the usual method) the resulting photograph appears perfectly flat and without detail.

For these reasons a special cylindrical speculum was constructed with lights incorporated within the speculum. It consists of a section of thin brass tubing 2 inches in diameter and 5 inches long with a $\frac{3}{4}$ inch bevel at the distal end. A special obturator with a long handle insures perfect ease of introduction. The inside surface of the tube is dull, (not necessarily flat black) to avoid light reflection from the walls. The obturator and the outside surface of the speculum are nickel plated and may be readily sterilized by boiling.

The speculum with obturator in place is introduced with the right hand, the left hand assisting somewhat in gently depressing the perineum. The obturator is now removed and the cervix presents itself into the beveled end of the speculum. By slowly rotating the speculum the cervix is now brought into the most favorable position, an attempt being made to deflect the cervix somewhat to one side, or forward or backward. The speculum will now stay in this position of its own accord and without discomfort to the patient.

The light carrier is now placed on the outside end of the speculum. This consists of a simple narrow metal band which fits around the speculum, carrying two radio dial bulbs and a light shield. The bulbs are of 2.5 volts each, give brilliant illumination and may be replaced at very small cost. They are both almost in contact with the inside surface of the speculum, but do not create enough heat to cause any discomfort. The light carrier does not need to be sterilized as it does not touch the patient. The most satisfactory source of current is a cystoscopic battery of dry cells with rheostat. The lights are now turned up to their full power.

Without turning the speculum, the light carriage is now rotated until the maximum shadow effect on the cervix is produced. This is usually greatest when the lights are in the quadrant opposite that to which the cervix points. These two principles, slight deflection of the cervix and eccentric lighting close to the cervix are paramount. The advantage of morning or afternoon pictures when shadows are present, over pictures taken in the midday sun, is well known to every photographer. By analogy, we are photographing a low mountain from an aeroplane by a nine o'clock sun.

Several points are of interest in deciding on the best position of the light or lights. To begin with, the source of light must be unilateral. If two lights are used on opposite sides of the speculum each destroys the shadows of the other, therefore the light source must be eccentric. Two bulbs are used because when mounted side by side, close to the inside surface of the tube, they do not encroach on the working aperture any more than one lamp. The additional brilliance obtained is of great advantage in reducing the time of exposure required for good pictures.

How close to the cervix should the light source be for optimum illumination? It must not be too distant or the perpendicular rays of light will produce no shadow. It must not be too close or a deep shadow will be thrown on the opposite side of the cervix, in which detail will be lost.

By repeated trials at different distances it was found that for the average cervix the optimum distance for the light was four inches. This produced the best photographic result in terms of light and shade. Since the cervix protrudes about one inch into the distal end of the five inch speculum, the lights were mounted just inside the proximal end.

Moreover, if the light source is too close to the cervix the photographic field will be obstructed. Let us take a trial photograph thru a simple hollow tube five inches long and two inches in diameter, with the camera lens eight inches from the end of the tube. The resulting photograph will contain a central round area representing the desired photographic field, and a wide peripheral zone representing the inside wall of the tube somewhat out of focus, which is of no interest.

It is apparent therefore that the aperture at the proximal end of the speculum may be quite small and still allow plenty of room for photography of the two inch field at the distal end, which is all that is desired. It was found by actual trial that the cervix could be photographed thru a hole the size of a penny at the outer end of the speculum with the camera lens 6 to 8 inches away from the speculum (10 to 12 inches from the cervix). The distal end of the speculum could still be seen in the photograph as a narrow rim around the cervix. This light carrier actually leaves an aperture of $1\frac{1}{2}$ x 2 inches, which is therefore quite ample. It allows the camera to be placed at a distance of 12 inches from the cervix without any encroachment on the photographic field.

This brings us to a consideration of the final test of efficiency of the speculum. Is the aperture at the proximal end of the speculum large enough to permit the camera lens to be placed at such a distance that

sufficient depth of focus is obtained? As stated before, the cervix protrudes one inch or less into the beveled end of the speculum. Using an F:2.5 lens stopped down to F:6.3 the maximum focal depth at a distance of 12 inches is exactly 1 inch. The speculum is therefore satis-

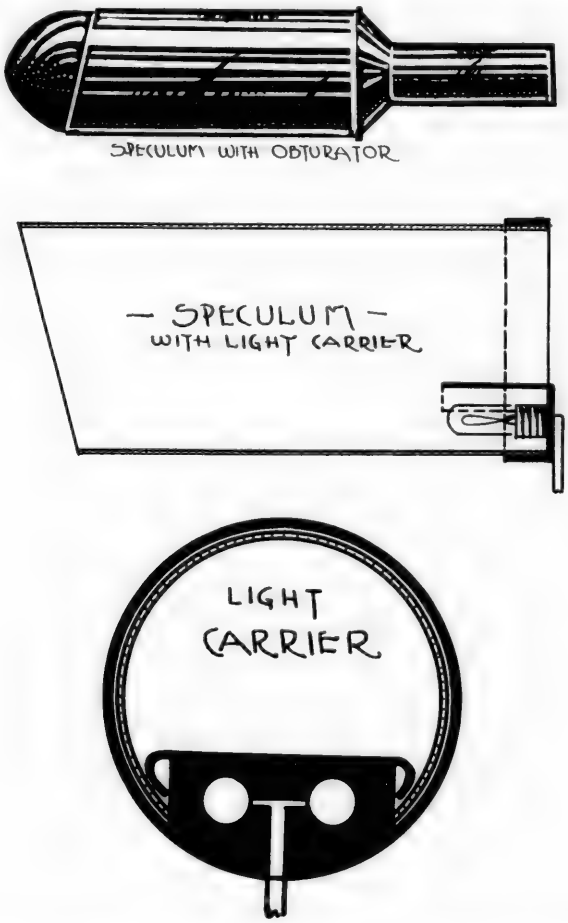

FIG. 1. SPECULUM FOR PHOTOGRAPHY OF THE CERVIX UTERI

factory from the standpoint of exposure of the subject, direction and intensity of lighting and finally it has an aperture allowing sufficient camera distance for proper focal depth.

A smaller speculum was constructed to be used in occasional cases in

which the larger one could not be introduced. The diameter of this instrument was $1\frac{1}{2}$ inches, but the other specifications were the same as the larger one. The only disadvantage of the smaller instrument is that on account of the smaller aperture the camera lens must be placed about two inches closer to the speculum. However, this does not reduce the focal depth appreciably and good results may be obtained. The larger instrument does, however, leave a small space on all sides of the engaged cervix. This gives a better opportunity for deflection of the cervix to one side, thus enhancing the shadow contrast.

If an excessive amount of mucus or pus is present this may be removed by gentle sponging with a few moistened cotton balls. We wish to emphasize that too vigorous wiping of the cervix or the use of mucus digestants such as caroid often starts troublesome bleeding which cannot be stopped and spoils the photograph. The less manipulation the better. The presence of mucus or pus, if it does not obscure the cervix, actually enhances the value of the photograph since it represents the natural condition present.

We now turn attention to the selection of a camera. Since the distance from the lens to the cervix cannot be more than twelve or fourteen inches, it becomes necessary to use a camera which focuses on ground glass. No fixed focus arrangement with front lens attachments is practical. Each patient presents a different problem and accurate measurement of the focal distance is next to impossible.

Sharpness and depth in the picture are of primary importance, and most lenses when working at this short range have a very slight margin of depth of focus. By stopping down the lens one can increase the focal depth somewhat, but this naturally must increase the time of exposure. The rule to follow here is to ascertain the lens stop which gives the maximum sharpness for the lens being used (this information is usually given in the manufacturer's pamphlet) and arrive at the correct exposure time by photometer or experimentation.

A question of importance is the film. Because of the small size of the negative used in this camera, a film possessing fine grain is desirable. The light intensity is sufficient for short exposures on this slower type of film. We have been using a film known as Eastman Background Film, which is approximately 25 per cent slower than Panatomic.

The film is developed in a borax developer similar to D-76. Due to the red color of the subject, a light green filter such as the Wratten # 51

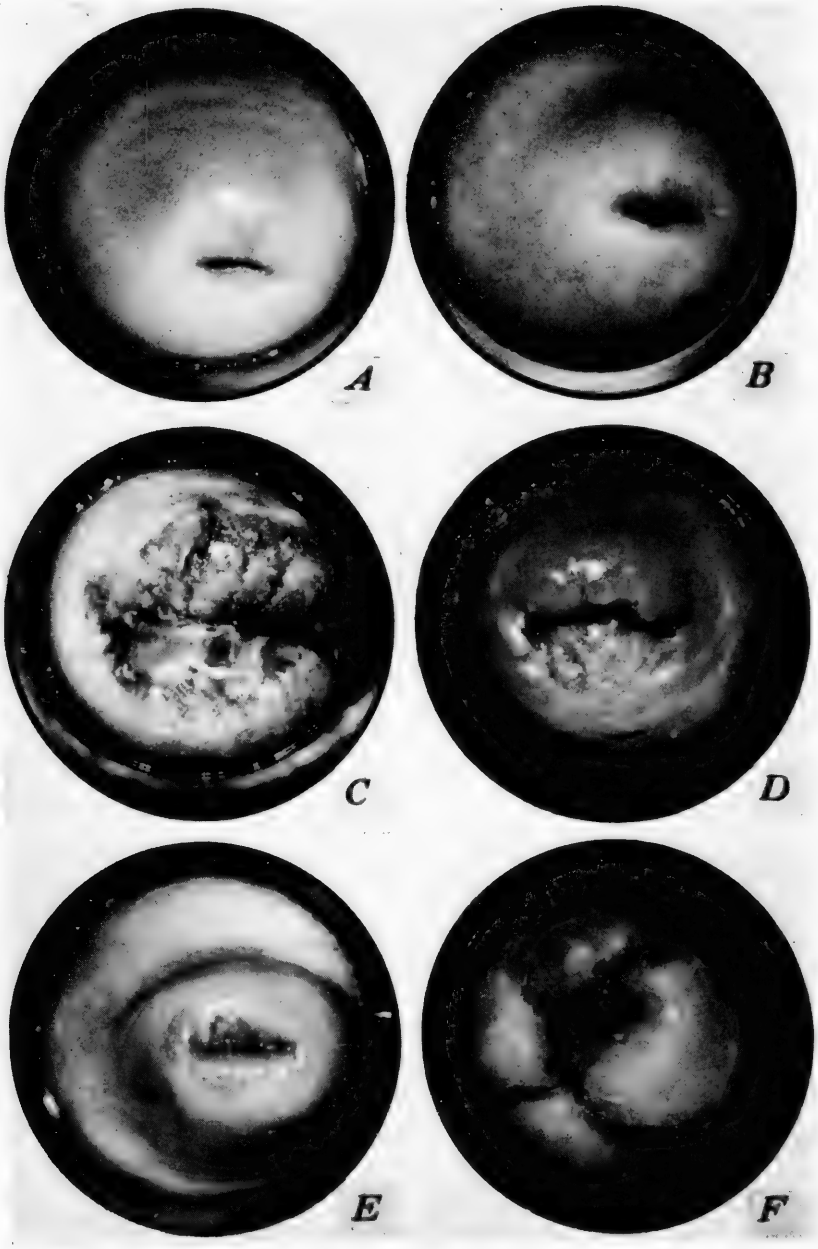

FIG. 2. PHOTOGRAPHS OF THE CERVIX UTERI MADE WITH THE EQUIPMENT DESCRIBED

A. Normal virgin cervix. *B*. Normal parous cervix. *C*. Cervix nine days after delivery. *D*. Badly lacerated cervix (17 children). *E*. Cervix with area of erosion. *F*. Old stellate laceration of cervix.

is employed. This filter tends to hold back the bright red intensity somewhat and, together with the D-76 developer, brings out excellent gradations in the finished picture. A very slight increase in exposure will be found necessary with the green filter, but this is permissible as the average patient is able to stop breathing for about five seconds, allowing ample time for the exposure.

An examining table which has an adjustable elevating device, so that the patient's hips may be brought to the proper level, greatly facilitates the work of the operator who sits on a low stool at the foot with the camera on a tripod in front of him. The lights in the room are lowered and those in the speculum, already introduced, are turned up. Care is taken to turn the light carriage so that the maximum degree of shadow is produced on and about the cervix, which, at best, presents little to convey an impression of depth in a photograph.

In order to secure a perfect focus on the cervix the authors use a small scrap of printed paper such as fine newspaper print as it is always easier to focus on printed matter than anything else. This paper is attached to a piece of string and placed on the cervix with the string hanging free outside the speculum. The purpose of the string is to permit removal of the printed matter after focusing without moving the camera.

In this work the authors use an exposure of three seconds on Eastman Background or Panatomic Film with a Hektor F:2.5 lens stopped down to F:6.3 The light source consists of two radio dial lamps turned up to their full current intake as described above. It is advisable to have the patient stop breathing at the end of expiration to avoid any strain on the pelvic floor. Slight respiratory movements at times cause movement of the cervix, no matter how rigid the speculum is held. The patient must coöperate for the best results.

A fine grain developer is essential for this film and if it can be obtained with a moderate degree of contrast to bring out the variations in light and shade a better picture will result.

Color photography of the cervix has been carried out along with this work using Dufaycolor Film and the results have been encouraging. These views of the cervix, when projected as lantern slides, reveal the true colors of the cervix and its various lesions. The only drawback to this kind of work is the excessive cost of this type of film in the 35 mm. width.

Many minor details have been left to the resourcefulness of the photographer and they will work themselves out as one applies the fundamental operations to his own equipment. After the routine is once established it becomes a simple matter to photograph the cervix.

THE USE OF THE INFRA-RED PLATE IN PHOTOMICROGRAPHY*†

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Since "resolution" is the distinct separation of the details in a structure, the formula—"the shorter the wave-length of light, the greater the resolving power"—would lead one to expect that the resolution obtained with the infra-red plate would be inferior as compared with that obtained with photographic emulsions which are sensitive to the shorter wave-lengths of light. Notwithstanding this fact, photomicrographs obtained with transmitted or reflected light with the infra-red plate are more enlightening in some instances because of the greater transparency and definition of structure obtainable. This is particularly true in routine microscopic sections of tissues which are heavily stained with any of the red or brown stains, or in tissue where the natural pigment is reddish or brownish in color. Another factor favoring the use of the infra-red plate in photomicrography with transmitted or reflected light, is the simplicity in the photographic technique.

The photographic method is essentially the same as that now in use with other photographic emulsions. No special equipment is necessary. However, the use of a color filter over the source of illumination is eliminated. Thus the color sensitive properties of the plate are utilized only. The results of the use of the infra-red filter with the infra-red plate in tissues in which visible light does not penetrate, are shown in a previous publication by the author.[1] In figures 1 and 3, the orthochromatic plate is used with the green filter placed over the source of transmitted light. In figures 2 and 4 the infra-red plate is used with transmitted light without a filter. In comparing figures 2 and 4 with figures 1 and 3, the former demonstrate quite clearly the excel-

* From the Department of Anatomy, Marquette University School of Medicine.
† Received for publication July 13, 1936.

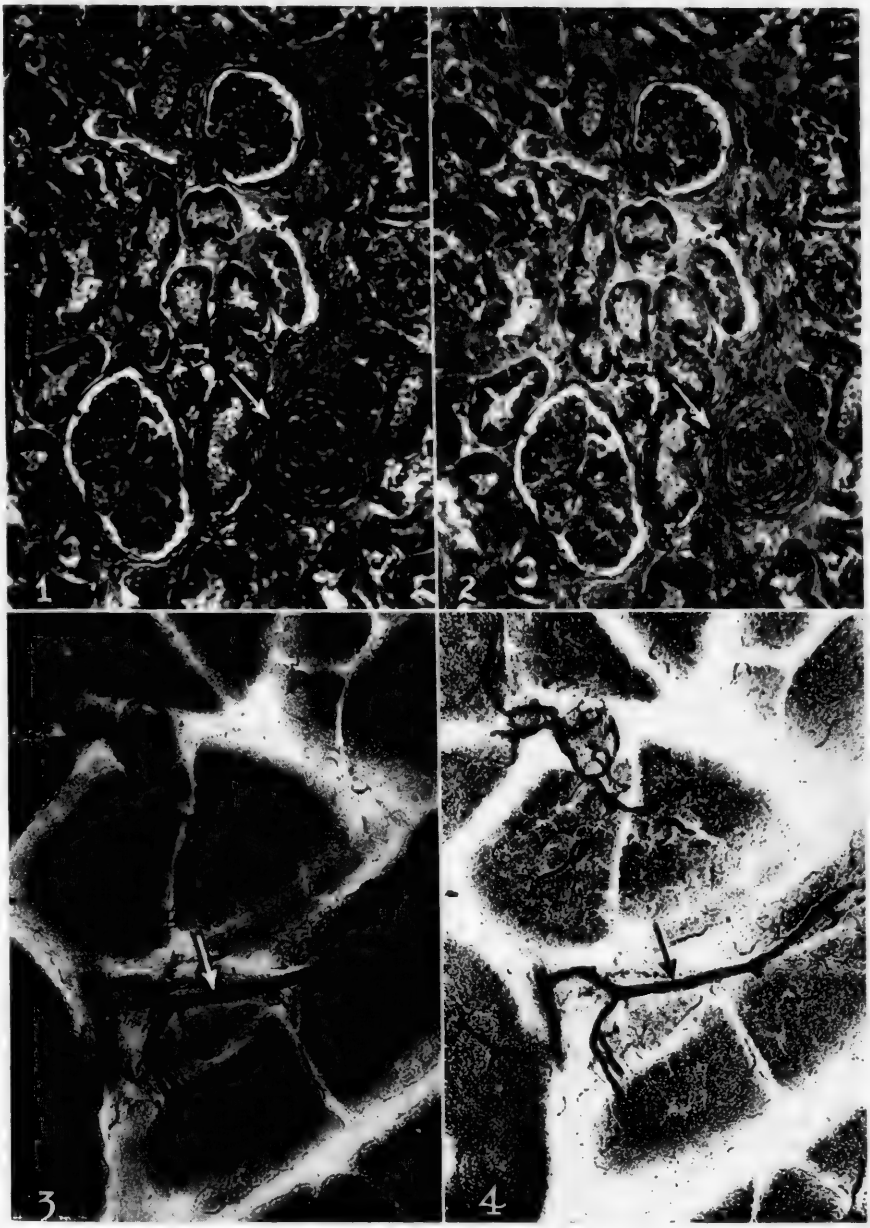

FIG. 1. PHOTOMICROGRAPH OF A SECTION OF A HUMAN KIDNEY

Haemotoxylin-eosin stain. Carbon-arc illumination, B filter, Eastman D.C. ortho plate. Exposure time 3 seconds.

FIG. 2. SAME AS FOR FIGURE 1 EXCEPT THAT THE EASTMAN INFRA-RED PLATE, TYPE 1R, WAS USED WITHOUT A FILTER AND THE EXPOSURE TIME WAS 1 SECOND

FIG. 3. PHOTOMICROGRAPH OF A SECTION OF HUMAN MUSCLE

The blood vessels were injected with gelatine and carmine. Carbon-arc illumination, B filter, Eastman D.C. ortho plate. Exposure time 3 seconds.

FIG. 4. SAME AS FOR FIGURE 3, EXCEPT THAT THE EASTMAN INFRA-RED PLATE, TYPE 1R, WAS USED WITHOUT A FILTER, AND THE EXPOSURE TIME WAS 1 SECOND

FIG. 5. PHOTOMICROGRAPH OF A PORTION OF A HUMAN FETAL EYE; THE VESSELS ARE PRINCIPALLY INTRA-SCLERAL VEINS AND ARTERIES

The iris, ciliary processes, and the rest of the choroid were removed. The arteries contain red cinnabar and the veins black India ink. Carbon-arc illumination, B filter, Eastman D.C. ortho plate. Exposure time 2 seconds.

FIG. 6. SAME AS FOR FIGURE 5 EXCEPT THAT THE ILLUMINATION WAS REFLECTED LIGHT FROM A 500-WATT LAMP, THE EASTMAN INFRA-RED PLATE TYPE 1R, WAS USED WITHOUT A FILTER, AND THE EXPOSURE TIME WAS 2 MINUTES

FIG. 7. SAME AS FOR FIGURE 6, EXCEPT THAT THE PLATE WAS EXPOSED TO TRANSMITTED LIGHT FOR ½ SECOND, AND THEN EXPOSED TO REFLECTED LIGHT FOR 2 MINUTES

lent color definition and separation of detail obtainable when using the infra-red plate without a color filter. In figure 2 it is to be observed that there is improvement in the separation of the detail in the sclerosed glomerulus in the lower right corner, while the nuclei in the other glomeruli and in the tubular structures are recorded with increased contrast. In figure 4 more transparency of the muscle tissue is obtained, with even greater transparency of the injected material within the blood vessels than that shown in figure 3. This figure also demonstrates excellent differentiation between the deep red color of the blood vessels and the brownish color of the muscle tissue.

In a publication by Swindle[2] in which he was concerned mainly with the blood vessels in the mucous lining of the nasal passages, the advantages of using the infra-red plate in conjunction with the injection of red cinnabar and combinations of red cinnabar with black India ink are quite obvious.

Figures 5, 6 and 7 are photomicrographs of a section of a human fetal eye prepared by Dr. Swindle after the method described in his publication. The large artery is packed with a water-cinnabar mixture, vermilion in color, while the veins contain black India ink. In figure 5, which was taken with transmitted light, with the orthochromatic plate and green filter, it is impossible to differentiate between artery and vein. Figure 6, was taken with the infra-red plate without a filter but with reflected light. It will be observed that in this photomicrograph the vermilion color of the artery is recorded with an unusual amount of brightness, as compared with the black color of the veins. However, if it is desirable to show less contrast between the artery and veins, the infra-red plate is first exposed to transmitted light and then to reflected light, figure 7. In this manner somewhat better definition of the structure is obtained without destroying the contrast between artery and veins. It is quite evident that with the use of the infra-red plate and this method of injection the photographer has fairly good control of photographic densities.

CONCLUSIONS

The use of the infra-red plate in photomicrography without a filter simplifies the photographic technique. By this method additional transparency of the tissue is obtained, together with better definition of anatomical structure.

Blood vessels injected with contrasting color media such as red cinnabar and ink can be recorded photographically with excellent contrast.

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THE USE OF MOTION PICTURES IN THE GENERAL BIOLOGY COURSE AT YALE*†

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During the last five years selected motion pictures have been used in the teaching of the general biology course at Yale University. Most of the films have been viewed with interest by the students, and examination questions based on the films have shown that some of the students have profited considerably from the films. Less than one-half of the films that have been previewed by the staff have been used in the course, and of these only a few have been entirely satisfactory. It is felt that films add to the course and an increased usage of them is planned, as satisfactory ones become available. The following discussion summarizes our experiences and the discussion is intended to stimulate the preparation and use of motion pictures.

The teaching film should present material that cannot be demonstrated better in any other manner. The peculiar advantages of the motion picture are important in recording the following types of material: (a) Life of organisms in their natural environment or showing their adaptability to unusual conditions. (b) Analysis of living processes by means of speeding or slowing phenomena not clearly seen at the normal speed, e.g., (1) Animal motion and behavior; (2) Developmental processes in both plants and animals; (3) Progressive reactions as in parasitism, disease, etc. (c) Demonstrations of processes which occur on too small a scale for presentation before an audience or for which

* From the Osborn Zoölogical Laboratory, Yale University.
† Received for publication July 1, 1936.

there is only one suitable viewpoint. (d) For the demonstration of a process, apparatus, and the proper technique of investigation or presentation.[1]

Sound films will be useful at the college level only when the personality of the speaker is of importance, or when the sound is part of the process illustrated, such as animal and diagnostic sounds, etc. A film of Gregor Mendel describing the experiments which led to his laws of heredity would be valuable and instructive. It is this type of material wherein the sound film seems to us to be preëminent. Sounds on a theatre screen are often faked and while that may be satisfactory there it is not appropriate when scientific fidelity is required. No sound film so far seen has been adapted to the course.

Due to the large enrollment, the students are divided into three general lecture sections and into eight laboratory-lecture divisions. Five instructors are in charge of the laboratory divisions and while each instructor follows the same schedule, the actual lecture must be adapted to the particular class. The instructors also have special interests which influence their teaching and this is desirable. Consequently a sound film on any subject is not equally adaptable to all divisions. We have yet to hear a sound discourse which was entirely free from errors of fact. This is a critical attitude, but necessary to maintain proper standards for the course.

An instructor has little choice with the sound film. If he wishes to make comments appropriate to his class it is necessary to shout above the recorded lecture. When the instructor decides to spend only a few minutes of the lecture time on the film it is not usually possible to show just part of a sound film. Recutting of sound film is a laborious and often an expensive process. With silent pictures each instructor can show those parts of the film appropriate to his lecture and can make such comments as are required. The rest of this paper will be restricted to silent films.

Size. Because of the restrictions of state laws the use of educational motion pictures will be limited in most cases to 16mm. prints.

With a 16mm. safety stock no fireproof booths are required, and the equipment is small enough to be used in any classroom or office. With optical printing a 16mm. print may be readily made from a 35mm.

[1] Standards for the motion pictures of biological material. *Jour. Biol. Photogr. Assoc.*, 1936, 4: 215–220.

negative. The recent powerful projectors are adequate to show 16mm. film to as large an audience as is likely in classrooms or in scientific society meetings. Another important advantage of the 16mm. film is lower cost. Any teacher may make motion pictures of material of special interest with this equipment. In fact, one solution to the problem of an adequate number of good films may be for teachers interested in particular subjects to make films and to share them with other teachers.

Length. Unless the teacher is planning a special program of motion pictures it is unlikely that more than fifteen of the usual forty-five or fifty minute lecture period will be used for film. This makes one four-hundred foot reel of 16mm. film a convenient unit. An example of good editing is the reduction of the three reel *Canti Tissue Culture* film to a very satisfactory one reel film by Dr. A. H. Estabrook, of the American Society for the Control of Cancer. Some shorter films are satisfactory as, for example, the hundred foot strip showing the budding of a yeast plant, but another film of the same length (100 feet) showing the flights of birds, was so crowded with detail as to be unusable. Most commercially available films show a regrettable tendency to add extraneous matter, such as the circus parade at the end of the film *Sexual Reproduction.* The same rules of good composition in writing should be applied to motion pictures regarding unity, relevance, emphasis, etc.

Titles should be too few rather than too many because the teacher can supply running comment as the film is shown. Fewer errors are then made by the producer. As an example, the film *Sexual Reproduction* had "Mulusk Larvea" in place of Mollusk Larvae which brought forth adverse criticism from the students. College students will not tolerate childish titles. For educational purposes the following suggestions summarize the proper use of titles.[1] The title should be adequate to name the film, to show the location of it in space and time, and to explain the script from which it was made. Titles should give the proper generic and specific names to prevent the inevitable confusion from common names which usually change from one locality to another. A motion picture film should conform to professional ethics and should not contain undue commercial or personal advertising.

Animation may contribute much to the analysis of a process or may spoil an entire film. In *The Frog* film the animation showing eating and the action of the digestive system is good, but that on the heart and

circulation seems to confuse the students. Slow motion photography is often preferable to animation. When the animation is less clear than the blackboard drawings of a good teacher, or contributes little more than what might be shown on charts or lantern slides, its use is not advisable.

Detail. Motion pictures are often shown in darkened rooms where it is not easy for the students to take notes. Consequently, a film should not contain more detail than can be remembered by the average student, otherwise the film must be repeated. Poor animation brings in detail that may cause a student to lose interest in the film.

All extraneous matter should be removed by vigilant editing. A film on *The Bee* was marked by an insert which showed a girl shaking petals from the branch of a tree onto an adolescent boy lying under it. One sympathizes with the college freshman who said under his breath, "If we must have girls, let them at least be good looking." Instead of this distracting scene a picture showing a bee pollinating a flower would have been interesting and profitable.

Whether to Rent or to Own. When finances are adequate each college department planning to use motion picture films should own the films. They may then be edited for use in the particular courses by cutting out unnecessary material and adding any material or titles required. By the purchase of a few films a year a suitable library may be built up without undue strain on the budget. We found that we used the Canti tissue culture film not only in elementary biology but also in the histology and the cytology courses. This makes it cheaper to own the film than to rent or pay transportation costs. Short films may be purchased to advantage, especially when the cost of production is reduced by the elimination of unnecessary titles. The *Rabbit Ovum* and the *Monkey Ovum*, films of Dr. Warren H. Lewis, are examples of this.

Rental films have the disadvantage that they are rarely suited to the class in which they are to be used, and all that the teacher can do about it is to show the part of the film that is pertinent. Usually it is the middle part of the film which is projected and the projector may be backed up for rewinding, but many times the urge to use the scissors nearly overcomes one's sense of fair play.

Rentals range from payment of the transportation charges on the films by commercial firms not in the motion picture business, to about five dollars a reel by a few firms who wish to make money rapidly. The

average rental has been just a little over a dollar per day for a four hundred foot reel. Some of the so-called free films (transportation cost only) are very useful in teaching, such as the *Intestinal Action* film of the *Petrolagar Laboratories*; the *Art of the Microscope* of the *General Electric Company*; and *Man Against Microbes*, of the *Metropolitan Life Insurance Company*. Such films may not be in as good condition as those where a rental fee is charged. One of the films received was very dry and brittle, and it had so many broken sprocket holes that it was very difficult to nurse it through the projector.

At first we found that rental films were sometimes shipped too late to arrive for the first morning classes, but this difficulty has rarely occurred of late. Such films are usually in good mechanical shape. In five years we have had only one that was not in good condition due to broken sprocket holes.

Film catalogs and sources. Lists of film sources have been published by the United States Government[2] and by other organizations.[3] From these one can obtain catalogs of films for the asking, with a few exceptions where there is a small charge. There is no way as yet of knowing from the catalog what the film will actually be and whether it may be usable in a given course. We make it a point to have several members of the teaching staff preview each film to decide whether or not it should be shown to the students. So far fully as many films have been rejected as have actually been used. Sometimes the catalog descriptions are misleading. A film entitled *Plant Life* was described among other things as showing "the development of the leaf and bud until full growth is attained." We rented the film to show the latter but found that it was not included and promptly sent the film back without showing it to the students. The firms do correct such errors when their attention is called to them but at present a school must be prepared to spend some money for the renting of films which will not turn out suitable for class use.

There is much film available which would be useful for teaching purposes such as short lengths from standard productions, and this material is to be found in stock film libraries. They are rather expensive due to

[2] Koon, C. M. Sources of educational films and equipment. Circular No. 150. United States Office of Education.

[3] Sources of biological motion picture films. *J. Biol. Photogr. Assoc.*, 1935, 3: 194–195; 1935, 4: 225, 231.

the high cost of locating the negatives in their enormous libraries. However, if a number of different schools could get together so that several copies of the material could be ordered at the same time, the cost per copy could be greatly reduced. It is unfortunate that some commercial firm has not seen the possibility of making available this material. For example, one recalls some of the animal pictures taken in the African films which would be useful in teaching. Should a sufficient number of teachers demand this material, it would undoubtedly become available at a reasonable cost.

Sometimes different distributors use different names for the same film, which leads to needless confusion and is a practice which should be discouraged. Some of the *UFA* films were very good despite the fact that they were planned for popular audiences. Since *UFA* has gone out of the rental business, these films can be obtained only from other libraries and there they may be found under different titles. Consequently, it is not always possible to know what film one is ordering. Teachers should insist that firms issuing catalogs give the original title and the name of the producer in case they have used a different name for the purposes of their own catalogs.

It has been suggested frequently that teachers should have their own accrediting and reviewing committees. This may be a solution of the problem of valuation. However, the use of a film is a personal matter and what may be useless film for showing in one class may be greeted with enthusiasm by another class or by another teacher.

Cost. Projectors are expensive and their high cost may prevent some schools from instituting a film service. Sometimes a projector may be borrowed from a parent, or a commercial firm selling photo supplies may be willing occasionally to loan or rent a projector. The less expensive projectors are quite adequate when the number of students in the class is small. A good screen may be obtained by painting a wall or movable support with a good grade of flat white paint. The actual screen part of a beaded screen may be purchased and mounted by the purchaser at a considerable reduction over the cost of the complete screen. Once the advantages of motion pictures in teaching have been appreciated, ways and means can usually be arranged to provide the necessary material.

Different courses will vary in their requirements for motion pictures and it seems futile to give any list of films that could be used in all courses

and we have by no means seen all the useful films. The following films were used during the school years indicated.

TITLE OF FILM	SOURCE	YEAR USED				
		'31, '32	'32, '33	'33, '34	'34, '35	'35, '36
Yeast budding	P	x	x	x	x	x
Flower life in the Yosemite (parts only)	K	x	x	x	x	x
Jewels of the sea	U	x				
Submarine camouflage	U	x				
Bee and spider	I	x				
Snail	U	x				
Intestinal action	A	x	x	x	x	x
Rocky mountain mammals	I		x			
Sexual reproduction of the oyster	F	x		x		
Canti, Tissue culture film (one reel version)	P	x	x	x	x	x
Frog	E	x	x	x	x	x
Cecropia moth	P			x	x	x
Lewis, Rabbit and monkey ovum	P	x	x	x		x
Man against microbes	I				x	
Living cells	I		x			
Traps for insects	C					x
Patton, Development of the chick	P			x	x	x
Butterflies and moths	I	x				
Richards, Ascidian development	P				x	x

Key: P = Privately owned; K = Kodascope Libraries; U = Ufa; I = Visual Inst. Service, Iowa State College; A = Petrolagar Laboratories; F = U. S. Bureau of Fisheries; E = Edited Pictures System; C = Institution Cinema Service; for addresses cf. references 2, 3.

The above comments summarize the experience and the views of the instructors in this department and are influenced by our own ideals and prejudices. They are presented here for their heuristic value, which we hope will stimulate the production of new films of superior quality and will encourage other teachers to use films in their own courses. Properly used they add much to the course and in the near future biology courses without motion picture illustration may be regarded as quite old-fashioned.

THREE-COLOR TRANSPARENCIES: A METHOD OF REPRODUCING MICROSCOPIC STAINED SECTIONS OF TISSUE*†

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Since it has been necessary to depart from the usual photographic technic in making a series of color transparencies of microscopic sections by the three-color process, a review of some of the problems involved may prove helpful. These problems may be divided into two general groups: (1) photomicrographic technic; and (2) the making of positive transparencies on "Eastman Wash-off Relief" film.

Color photomicrography is necessarily more exacting and critical than ordinary photomicrography. The alignment of the entire system must be accurate, optically and mechanically. To eliminate color fringing, apochromatic objectives and compensating eyepieces, as well as an aplanatic substage condenser, must be used. Even with this corrected optical system, however, a difficulty will sometimes be encountered, such as chromatic aberration of magnification, due to the inability of apochromats to keep all three images the same size even though they are in the same plane. The microscopic sections for reproduction should be carefully chosen, paying particular attention to color contrast and color strength. It may be necessary to restain some sections to obtain sufficient contrast for photography. It is useless to attempt to get a good color photograph of a section which lacks good color.

As routinely stained sections vary greatly in color (hematoxylin and eosin stains, for example) experienced judgment must be exercised in deciding upon exposure and development. Average sections require a contrasty developer to keep the white portions from clouding over. This is particularly true of low powers. Magnifications of 200 and higher, sections containing excessive color contrast, and deeply stained sections, require a less contrasty treatment. Generally, crisp negatives are necessary for best results, which is contrary to the usual recommendations for color work.

The Eastman D-19-b developer, of modified high contrast, works very well. Contrast may be controlled by varying the development time.

* From the Photographic Department of The Mayo Clinic.
† Received for publication May 11, 1936.

As many hematoxylin and eosin stained sections contain no yellow, a two-color technic is possible. Only two negatives are made, using the A and B filters of the Wratten tri-color series. The resulting transparencies are satisfactory in every respect. A moderate yellow-red can be recorded with this technic by employing a yellow-red dye bath for the positive, but at best it is a poor substitute for a separate yellow-dyed positive made from a third negative.

The three negatives are given identical development. The C filter negative will have a slightly lower gamma than the A and B filter negatives, but this does no harm. Uniform treatment saves considerable time if much work has to be done.

Except with extremely low powers, it is impossible to use any neutral scale, which is so necessary in judging the uniformity of three-color negatives. A fair substitute for a grey scale is any grey area of the negative, representing a clear white portion of the original. By this means uniformity can be judged as well as the exposure necessary in the making of the positives.

Owing to limitation of the optical system it may be found that a desired magnification, in combination with a desired field, will not yield a sharp image over the entire plate. Recourse may be had to an objective of lower numerical aperture, plus an extended bellows, or to a lower eyepiece and increased bellows extension. Too, it will be found that while the red and green filter images have a mutual focus, the blue filter image will be fuzzy. The remedy is in refocusing the substage condenser, with the C filters in the light beam, so that the image of the field diaphragm is in focus in the object plane.

THE MAKING OF POSITIVE TRANSPARENCIES ON EASTMAN WASH-OFF RELIEF FILM

The characteristics of the Eastman positive film and the processing of it are so adequately dealt with in their new pamphlet (April, 1936) that the following remarks will have to do solely with aids in technic.

Owing to the extremely short scale of the positive film, exposures must be quite accurate; hence some means of measuring densities in the three negatives is essential, as increase in density and increase in exposure are not directly proportional. Here again a grey scale, or its substitute, is invaluable. Readings are taken on the three negatives, and any slight error in negative exposure must be compensated for in figuring

the exposure for the positive. The writer used a makeshift, consisting of a numbered density strip-wedge which was matched with the grey scale (or its equivalent) in the negative. The number on that step of the wedge which matched the negative in density indicated the exposure necessary for the positive, a matter which had been predetermined by tests and by trial and error. Any system of measurement tends to be quite arbitrary, so it is most important always to bear in mind the color and contrast of the original and to make allowances for such factors in deciding on the exposure necessary.

The exposure of the positives is by the violet light of the number 35 filter, which has a multiplying factor of 3. The Eastman booklet gives very helpful suggestions as to exposure by comparison with certain photographic papers. Overexposure of the positive is the most common error, as the light is very deceiving.

In developing the film it was found best to develop it face down. As the film is exposed through the back, the image naturally is first visible on the back. The image builds up rapidly at first and seems to gain very little added density toward the end. Development must be complete. The yellow dye in the film develops out with no effect on the solution, so the developer can be used repeatedly. Tank development is thus possible, though it is slightly longer than tray development. Using a separate tray for each film saves considerable handling in the processing of a set. With either the tank or tray method, agitation of the film is necessary to insure even development.

Using the red printer image as a guide, the appearance of the completely developed image should correspond to an Azo print, which is somewhat darker than normal.

The hot water development or "washing down" of the bleached image can be accomplished in any of several ways; in a deep tank or pail by rocking in a tray, or by rapidly pulling the film through a tray until no more gelatine can be washed down. The essential thing is plenty of clean, hot water and several rinses. The temperature of the water is not critical, as the gelatine starts washing out at 100°F. and can stand as high a temperature as 125° or 130°F. More care must be exercised at these high temperatures to avoid loss of delicate structures. Any clear white portions which seem to be fogged over can be cleared by rubbing with the fingers, or with a tuft of cotton on a toothpick, while viewing the positive by transmitted light. Extreme care

must be used, however, not to touch any portion of the positive essential to the picture.

The dyeing of the positives, and corrective treatments for correct color reproduction, are best achieved by following the Eastman technic. When the dyed transparency is satisfactory and checks with the original, it may be varnished to obtain increased brilliance. After thorough drying the three are superimposed, yellow on the bottom, red next, then blue, each being trimmed $\frac{1}{16}$ less on each side, and they are then bound with tape. A sheet of glass over all but the edge being bound will eliminate bulges and aid in retaining register until binding is complete.

THE APPLICATION OF A NEW POSITIVE TRANSPARENT FILM TO CLINICAL PHOTOGRAPHY*†

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The value of photographs as an adjunct to clinical conferences, lectures and scientific exhibits is so well recognized and appreciated that nearly all well prepared papers are now enhanced and clarified by photographic illustrations of some kind.

Lantern slides, contact prints, enlargements, and radiographs are the usual means of demonstrating material of medical interest. Often, especially in smaller hospitals, the use of lantern slides is prohibitive because of the cost of materials, lack of time or inexperience in the preparation of lantern slides, or lack of a suitable projector. In such instances it is not unusual to see contact prints handed from member to member of an audience during the presentation of an address, but this is a pernicious practice, leading to distraction from rather than to interest in the subject, and is often worse than having no photographs at all.

Radiographs have always appeared to be an ideal medium for illustrating clinical conferences because of their translucent character and clarity even when viewed from a considerable distance, but their use is distinctly limited to one field.

* From the Eugene Littauer Memorial and Fulton County Laboratories, Nathan Littauer Hospital, Gloversville, N. Y.

† Received for publication June 16, 1936.

The recent introduction of a transparent positive film into the field of commercial photography indicated the possibilities of the use of such a film in clinical and gross photography where lantern slides were not available. The application of this transparent film to medical photography has been under investigation since June, 1935, with the cooperation of the manufacturers.

Safety Translite Film, made by the Eastman Kodak Company, is a double-coated, translucent, matte film with a positive emulsion. It is handled exactly like printing paper. Enlargements can also be made of suitable subjects. Being translucent, Translite film must be viewed by transmitted light. X-ray viewing illuminators are suitable for this purpose, and a battery of three or more may be set up in a conference or lecture room.

The double-coated surfaces of Translite film combined with translucence and the use of transmitted light present a remarkable effect of depth, far in excess of that of ordinary prints. This third dimensional effect of Translite film is highly desirable and is most effective in the portrayal of solid organs, such as the heart, kidney, spleen, brain, nodular regions or growths on flat surfaces, etc. The film may also be used to demonstrate suitable clinical subjects and for reproduction of radiographs and photomicrographs, but the degree of depth obtained with these is naturally not so striking due to their original plane surfaces.

Unfortunately, the illusion of depth created in Translite prints cannot be preserved in photo-engravings, making it impossible to illustrate this paper with typical Translite prints.

The chief limitation in the use of this film for printing lies in its high contrast, which proves detrimental in clinical photography where contrast must be partially sacrificed for the preservation of detail. Reduction of contrast in original negatives lessens the contrast of Translite film positives, but where these same negatives must also be used to make paper prints, as for photo-engravings, this method is not wholly satisfactory. However, at the present time the use of soft negatives to print on Translite film affords the only certain means of obtaining a good degree of contrast without any noticeable loss of detail. Attempts to reduce contrast by the use of a single-coated Translite film, specially prepared for us by the manufacturers and not available for general use, were not entirely successful.

Safety Translite film is not practical for large audiences because of

the limited size of prints or of clear enlargements, but it presents a valuable means of realistic portrayal of pathological specimens for scientific exhibits, and is useful in illustration of cases for presentation to small conference groups and for lectures to medical and nursing classes.

PRINT CRITICISM

LEONARD A. JULIN

Rochester, Minnesota

At most scientific meetings one often sees lantern slides which are weak and muddy in appearance. This is usually due to improper manipulation in processing the slide. An example of this kind is shown in Figure 1, which represents a lantern slide submitted for criticism. Figure 2 is another slide made from the same negative but with different handling.

These slides were printed by contact using Eastman Slow Plates and developed in D-34 (70°F.), as recommended by the manufacturer. Figure 1 was given an exposure of 10 seconds and developed for 1½ minutes. Figure 2 was exposed for 6 seconds and developed for 3 minutes. It will be noted that the same type of plate and the same developer were used for both slides, only the duration of exposure and development being varied.

Unlike contact prints which are usually fully developed in 45 seconds, lantern slides must be developed from 1½ to 3 minutes. The importance of this full development should be emphasized if best results would be obtained. The unskilled worker has a tendency to over-expose and under-develop slides. This fault should be corrected.

Plate manufacturers supply lantern slides in several degrees of contrast and also furnish developing formulas giving added control of contrast. By following their directions it is a simple matter to make brilliant slides from almost any negative. Any trace of fog in the slide can be eliminated by a brief immersion in a weak solution of Farmer's reducer. This is a routine procedure in many photographic laboratories and is recommended.

FIG. 1

FIG. 2

PHOTOGRAPHIC TECHNIC, NEW PROCESS AND EQUIPMENT*

F. R. HARDING

Boston, Mass.

ACETATE FILM CEMENT

An easily prepared motion picture film cement formula for use with "safety" or acetate base film is as follows:

Ethyl acetate	3½ oz.
Acetone	3½ oz.
Acetate base (Film clippings, free of emulsion)	30 gr.
Acetic acid	1 oz.

This formula is excellent.

Through the coöperation of the Bausch & Lomb Optical Co. and the Eastman Kodak Company, a new apparatus has been designed for making microscopic movies. The use of the 16 mm. camera has previously been somewhat limited in the scientific field. The cost of fitting up a movie camera to make microscopic movies ran well over the thousand dollar mark and was limited more or less to 35 mm. cameras and film.

Now the Ciné-Kodak Special may be used with a special observation eyepiece, developed by Bausch & Lomb, which acts as a beam splitter. The beam splitter eyepiece is fitted to the front of the camera in place of the regular camera lens. In the beam splitter is a 45 degree prism, silvered but unbacked, which causes part of the light to be reflected to the film and part to be transmitted through the eyepiece so that the operator can observe the action and the field while the picture is being made.

The observation eyepiece sets into a flange placed on the microscope eyepiece so that a light, tight seal is made between the two elements. This accessory can be fitted to any microscope.

Not only can films be made easily in black and white, but with the new Kodachrome film pictures in natural color can be obtained. The use of color film with polarized light produces some extraordinary results. The growth of crystals of organic compounds in regular and slow motion, filmed with polarized light, gives a mixture and change of color in the crystals of extraordinary beauty.

Doctors, medical students, and all scientific workers can make records in monochrome or color, for purposes of record, teaching or scientific study. The amateur, at modest expense, is enabled to secure beautiful and unusual films of the activities of live specimens.

A one-case, moderately priced, 16 mm. sound-on-film reproducer, Filmosound 138, is announced by Bell & Howell Company.

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* From the Department of Photography, Children's Hospital.

Light (weighing 57 pounds complete), compact, and readily portable, it is ideal for salesman's use in offices, schoolrooms, and exposition booths, for educational use in school classrooms, and for home entertainment. Yet its portability, convenience and moderate cost have been achieved without sacrifice of the high standard of quality always synonymous with the Bell & Howell name. Filmosound 138 consists essentially of the time-tried Filmo projector for showing the pictures, plus a remarkably effective sound-on-film reproducing system: sound head, amplifier, and speaker.

The sound head is entirely new, embracing a rotating sound drum and a film shrinkage compensating "floating idler." A balanced flywheel, rotating as an integral part of the sound drum assembly, assures constant speed and hence freedom from sound "flutter." Voltages on exciter lamp and photo cell are automatically balanced as the volume control is changed, thus providing an automatic "photo-hiss" eliminator. Synchronization of pictures and sound is perfect.

Filmosound 138, with all necessary parts, packs into a single case, 8½ by 18 by 29 inches. It will fit nicely into the back seat of an automobile or under a Pullman berth. This case also accommodates a 1600-foot reel of film in humidor can . . . a 45-minute show in a one-hand package. For use the projector and amplifier (in one unit) are removed from the case. The case then serves as a baffle for the built-in speaker.

This machine uses a 750-watt lamp and may be operated at either sound or silent film projection speed (24 or 16 frames per second). A fast 2-inch projection lens is standard equipment. Other sizes to meet all projection conditions are available as optional equipment and may be interchanged without use of tools.

The same photo cell and exciter lamps are used as in previous Filmosound models but all other amplifier tubes are of the new metal type.

The finish is in gray damaskene. The carrying case is covered with an attractive, gray fabricoid to match. A new type of convenient one-hand tilt rod, a motor re-wind, and a reel arm which can be quickly attached with one screw are also features of this really notable new sound reproducer.

Bell & Howell Company announces a new edition of its catalog of Sources of 16 mm. Films on Geography, Travel, and Natural Resources. The purpose of the catalog is to indicate as completely as possible the films available in this field and where they may be obtained by free loan, purchase, or rental.

Especially noteworthy is the large number of sound films listed—87 in all. Among them are several of feature length, such "Thunder Over Mexico," "Isle of Peril" (life on the Faroe Islands), "Matto Grosso" (River of Doubt country in South America), "N'Mango" (British Cameroons), "Trekking to Timbuctoo," and "This is America."

Also listed are timely sound film shorts, such as "Ethiopia" and "The Winter Olympic Games in Germany," several sound films on travel in Germany, three on coal mining, as well as a number on tractors and oil.

The National Park Service now has a full dozen films on National Parks, CCC and ECW work.

Among new silent films is a fine listing of hunting and fishing subjects available through Field & Stream Magazine and the South Bend Bait Company. There are, too, films available on the construction of Boulder Dam.

A Kodachrome silent film on Bermuda is listed as available from the Cunard White Star, Limited.

The catalog may be obtained from Films Division, Bell & Howell Company, 1801 Larchmont Avenue, Chicago, by sending 25 cents in stamps to help defray the cost of preparation and mailing.

A valuable and interesting catalog on accessories for 16 mm. and 8 mm. Filmo motion picture cameras and projectors has just been issued by Bell & Howell Company for free distribution. Profusely illustrated, with a beautiful three-color cover, its sixty pages are filled with worthwhile formation.

It is a helpful handbook as well as a catalog, for it does not stop with picturing and describing the equipment which it offers for sale; it goes on to tell what the various classes of equipment contribute to the movie user's art, and how they should be used to best effect.

Many new accessories are revealed in this booklet; new exposure meters, new lighting equipment, auxiliary camera equipment for advanced cinematography, an entire new line of film editing equipment based upon an entirely new film splicer; and many others.

As indicated by the table of contents, the book is arranged in sections, each devoted to a related group of units. Fully 500 separate accessory items are listed, which gives an idea of the comprehensiveness of the catalog. Everything from a camera aperture brush to portable gasoline-engine-driven generators for operating Filmo projectors and Filmosounds, is given due place and description.

Copies of the catalog may be had without charge by request to Bell & Howell Company, 1801 Larchmont Avenue, Chicago.

Association News

The Biological Photographic Association extends a cordial invitation to all interested photographers and scientists to visit the Sixth Annual Convention in Boston, September 24–26, 1936. The sessions will be held in the Hotel Lenox.

Exhibits will comprise the annual print display in addition to modern photographic apparatus.

Mr. F. R. Harding is in charge of program and exhibit arrangements. He may be addressed at the *Children's Hospital*, 300 Longwood Avenue, Boston, Mass.

Further details concerning the convention may be found elsewhere in the JOURNAL. However, all members are urged to attend for some rather important contributions to photography will be made during the course of the meeting.

* * * *

An excellent article, *Infra-Red Photographic Study of the Changing Pattern of the Superficial Veins in a Case of Human Pregnancy*, by Leo C. Massopust of the Marquette University School of Medicine, appeared in *Surg., Gynec. & Obst.*, 63: 86–89, July, 1936. Those interested in infra-red medical photography should read Mr. Massopust's well illustrated paper.

* * * *

THE JOURNAL OF THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION has been greatly aided through the graciousness and industry of Miss Virginia Benedict of the Osborn Zoological Laboratory, Yale University. Miss Benedict prepared the index to volumes 3 and 4 of the JOURNAL, which is enclosed with this issue. Our many thanks are extended to her for the excellence of this laborious piece of work.

* * * *

Those members who plan to exhibit prints at the forthcoming meeting of the B. P. A. will do well to consult again the rules laid down for the Print Exhibit. The rules will be found in the June number of this JOURNAL.

* * * *

Dues are now due. Please mail your checks for $3 to Miss Anne Shiras, Magee Hospital, Pittsburgh, Pa. If a *Sustaining Member*, send $10. New members are coming in rapidly and charter members are urged to maintain their uninterrupted membership.

* * * *

A reprint of an article, *Making the "Intermediate Negative" in Copying Radiographs*, may be secured gratis by writing to the *Medical Division*, Eastman Kodak Company, Rochester, New York. The clinical photographer who is engaged in this type of work will find the data contained in this article of substantial value.

The following members were elected officers of the Boston Chapter at the July meeting:

Edward P. Oxmard.....*President*
Dr. C. T. Brues.....*Vice President*
Lawrence B. Brown.....*Secretary-Treasurer*

Messrs. F. R. Harding, Adrian Iorio and R. W. St. Clair, were elected to the *Executive Committee.*

* * * *

Equipment for clinical photography is listed, and film emulsions preferred for various types of work are discussed in an article, *Clinical Photography*, by R. H. Mercer, *Photo Art Monthly*, 3: 551–4, Nov., 1935. Over-all lighting without shadows with one light closer than the other is suggested. Sterilized strips of black satin are used as a background for many subjects. The choice of filters is discussed. When photographing surgery, especially abdominal operations, the use of a large, optically flat mirror over the patient has been found effective.

* * * *

We wish to welcome the following new members to our Association:

Dr. W. C. Alvarez, 815 S. W. 5th St., Rochester, Minn.
Dr. A. J. Bruecken, 1436 Barnesdale St., Pittsburgh, Pa.
Dr. John Downing, 520 Commonwealth Ave., Boston, Mass.
Marie Eubanks, 1127 S. 12th St., Birmingham, Ala.
Russell B. Harding, 32 Princess Road, West Newton, Mass.
Chester O. Henry, 3005 Gilmore St., Wilkinsburg, Pa.
Dr. Joseph J. Jenovese, 450 Glenn Avenue, Ellwood City, Pa.
D. Hope King, 12 LaGrange St., West Roxbury, Mass.
Dr. Charles S. Lipsitt, 337 Union Street, New Bedford, Mass.
Stanley J. McComb, 1026—6th Ave., S.E., Rochester, Minn.
Jack Pirsonick, 537 Herzl Street, Brooklyn, New York.
Francis M. Putnam, 92 Henry Street, Cambridge, Mass.
Irving Rehman, 477 First Ave., New York City.
Sidney E. Riesner, 136 East 36th St., New York City.
E. S. Rinaldy, Chester, N. J.
Prof. Walter E. Rogers, Lawrence College, Appleton, Wisconsin.
Dr. C. J. Sapp, Highland Building, Pittsburgh, Pa.
Charles Schroeder, Zoological Hospital, Balleda Park, San Diego, Calif.
Eucephus Stephens, 15 Whittlesey Ave., New Haven, Conn.
George E. Stone, P. O. Box 341, San Jose, Calif.
Walter L. Thompson, 5604 Ellsworth Ave., Pittsburgh, Pa.
Dr. Wm. Niles Wishard, Jr., 1711 N. Cap Avenue, Indianapolis, Indiana.

Dr. George H. Semken, Institute of Cancer Research, Columbia University, New York City, has been enrolled as a Sustaining Member.

ARTHUR W. FUCHS.

VOLUME V *December, 1936* NUMBER 2

The Journal of the
Biological Photographic
Association

POLARIZED LIGHT IN PHOTOMICROGRAPHY, ITS PRINCIPLES AND APPLICATIONS*†

THELMA T. BAIRD

Chicago, Illinois

Before discussing the optical principles of polarized light it is advisable to review the wave theory of ordinary light. It is almost impossible for our ordinary human intellect to comprehend light waves without imagining a medium in which they must occur. So we assume the existence of a vibrating medium, a medium supposed to be a rare, highly elastic fluid occupying all space and all bodies. We call this "ether." It penetrates the interplanetary spaces as well as solids and is composed of minute molecules having attractive and repulsive forces. When these bodies are at rest, or in equilibrium, any attempt to move one particle would move or agitate others. These in turn would move more, thus extending the disturbance. When a stone is thrown into a pool of water it displaces and forces some of the water up into an elevation or wave about it. This accumulation of water is heavier than the surrounding water and tends to return to equilibrium, but its momentum carries it past the normal level into another elevation, and a hollow or trough is formed. Adjacent water tends to fall into this trough, thus setting up a system of waves which is visible long after the original agitator, the stone, has dropped to the bottom. We are all familiar with this fact. In a similar manner the same condition is set up in this delicate, elastic

* From the General Biological Supply House.

† Read at the 1935 Convention of the Biological Photographic Association.

medium we call "ether" when it is disturbed. The wave theory of light may be assumed to be a disturbance, a motion, or a vibration of ether particles.

Light is also considered to be a transverse vibration, i.e. if light should be traveling north the ether particles would vibrate up and down, east and west, or in some direction in an east and west vertical plane. It is thus the resultant of two rectilinear vibrations at right angles to each other. For example, let the path of an ether particle during a short interval of time be represented by the convoluted line in the diagram (Fig. 1), the beam being perpendicular to the screen. Any actual motion at any instant may be considered as composed of an up and down motion a b, combined with a sidewise motion in the direction c d.

Any circumstance which would suppress one of the component vibrations without affecting the other would leave the particle oscillating

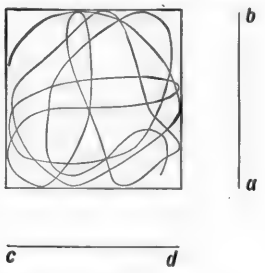


FIG. 1

Textbook of Physics, A. L. Kimball, Henry Holt and Company, New York, 1917.

along a straight line. Suppose all of the vibrations at right angles to its axis a b are absorbed leaving only those which are parallel. The light will then be vibrating in one plane only and is said to be polarized.

The naked or unassisted eye cannot distinguish polarized light from ordinary light. Every one has seen polarized light but has been unable to recognize it. Part of the light reflected from a highly polished mahogany table top between us and the window is polarized. If we should look obliquely through a plate glass window at some dry goods on display, we would find that part of the light is again polarized. The atmospheric light is frequently polarized when the solar rays fall very obliquely on the earth's atmosphere (early morning and late evening). However, to reveal its peculiarities some agent or test must be employed to detect the presence of polarization. In the field of optics such an agent is called an analyzer.

Light may be polarized by three methods. First, by reflection; second, by tourmaline plates; and third, by double refraction.

When light falls upon a smooth glass plate at a moderate angle, 4 to 5% of it is reflected. If this reflected beam falls upon another piece of glass, it is reflected a second time. However, if the second glass is rotated through an angle of 90°, using the once reflected beam as an axis and providing the angles of incidence are equal at certain positions, the second surface will not reflect the beam. In Figure 2 the positions in which the light will be reflected are shown at a and b.

Tourmaline, a mineral which occurs in crystals, also exhibits polarizing properties. If two plates of tourmaline (Fig. 3) cut parallel to the axis

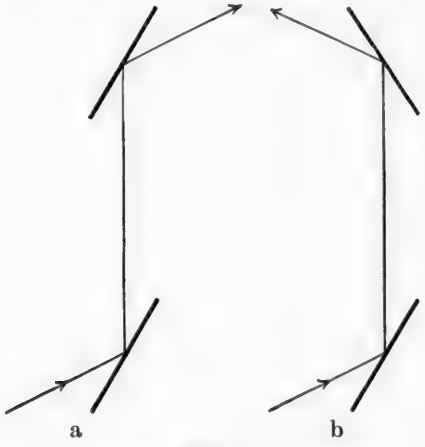


FIG. 2

A Survey of Physics, F. A. Saunders, Henry Holt and Company, New York, 1930.

of the crystal are placed one upon the other with their own axes parallel, light will be transmitted through both plates of tourmaline. However, if one should be rotated upon the other, the transmitted beam will fade until there is complete extinction when the two are exactly at right angles. It would seem that the light after passing through the first plate of tourmaline is different from ordinary light, as the second plate must be so oriented that its axis is in a particular direction in order to continue transmission of the beam. Therefore, we assume that the nature of the light has been changed, that the first plate of tourmaline, the polarizer, has absorbed all of the transverse vibrations and transmitted only those which were parallel to its axis. Thus the beam of light was vibrating only in one direction.

The third method of polarizing light is by means of double refraction. This can be observed in a great variety of crystals, quartz and calcite being the best known. If a crystal of calcite is placed over a black dot on a sheet of white paper, two dots will be apparent; if the crystal is

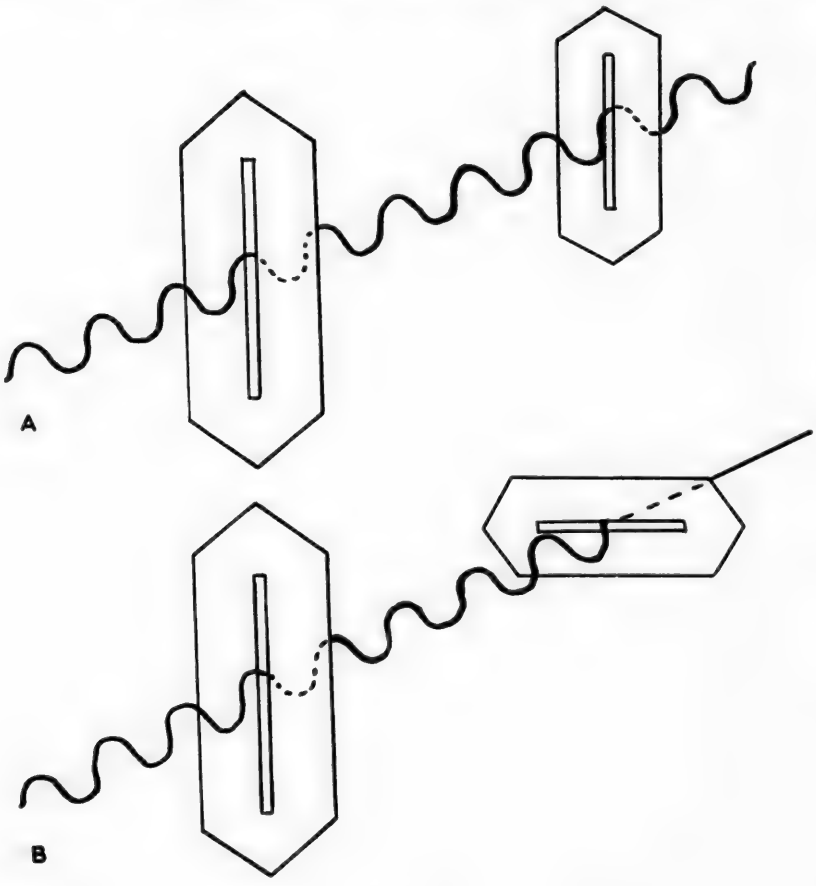


FIG. 3

rotated on the paper, one dot will remain stationary while the second revolves around it. This phenomenon is due to ordinary light splitting into two rays when it passes through calcite. Both of these rays are polarized light, but each has a different angle of refraction and a different velocity in the calcite crystal.

This peculiarity of calcite is utilized as the principle of the Nicol prism. In arrangement the Nicol prism (Fig. 4) is fairly simple. Two pieces of calcite are cut in a special manner and cemented together with Canada balsam C B so that one of the rays of light O can be completely reflected and absorbed by a layer of black paint on the lateral surfaces of the prism. Thus only one ray of polarized light is permitted to pass through.

Microscopic examination with polarized light does not involve any alteration of the specimen yet it may reveal structural features better than elaborate chemical treatment or staining methods. However, the extent and accuracy of observations made with a polarizing microscope depend upon three factors, the knowledge and skill of the observer, the

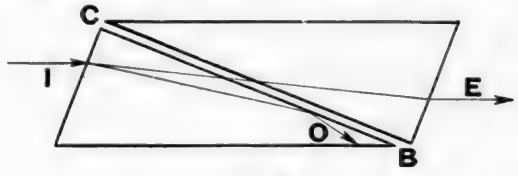


FIG. 4

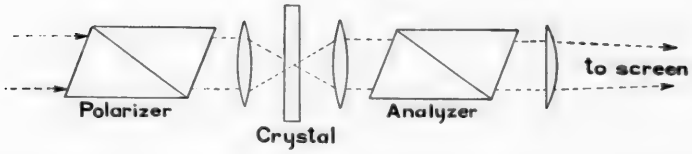


FIG. 5

A Survey of Physics, F. A. Saunders, Henry Holt and Company, New York, 1930.

perfection of the apparatus and a thorough knowledge of fundamental optical principles, as "rule of the thumb" procedure is likely to lead to error.

For detailed quantitative study it is impractical to convert an ordinary biological microscope by attaching polarizing apparatus to it, as the resulting instrument will serve only for the simplest of observations. However, for qualitative observations polarizing devices have been found to be quite satisfactory. The essential parts of a (Fig. 5) polarizing microscope are:

1. Polarizer
2. A special lens system called the condenser
3. Analyzer

4. Cross-haired eyepiece, fixed so as to indicate orientation of the polarizer and analyzer
5. Suitable mountings to permit the rotation of the specimen

The polarizer is carried in the substage together with the condenser and the iris diaphragm. The objectives are interchangeable. The analyzer is carried above the objective in such a manner that it can be withdrawn or returned to the body tube. A rigid bar is supported at the level of the stage by an arm rotating through 90° fitted with verniers for reading the angle of rotation. In Figure 6 the camera is in situ.

Certain substances in nature show identical optical properties and are spoken of as being optically isotropic. These substances show up black under the polarizing microscope.

However, most crystals and colloidal substances exhibit definite optical properties and are said to show optical anisotropy or double refraction or birefringence. These substances appear light in the microscope. Without becoming involved in physical chemistry it will suffice to say that the isotropic and anisotropic characters of substances make possible the contrasting and delineating images seen through the polarizing microscope.

Let us now examine an anisotropic substance between the Nicol prisms on the stage of the polarizing microscope (Fig. 7). Upon rotation of the stage the material will appear alternately light and dark with complete extinction at 90° intervals. Complete extinction is shown whenever the planes of vibration of the specimen are in exact alignment with those of the cross Nicol prisms. Under these conditions the polarized light from the polarizer is already vibrating in one or the other of the two planes, p or p′. Since the vibration planes of the doubly refractive specimen are the same, the light undergoes no change from its original plane of vibration and is completely stopped by the analyzer. In its position of extinction, p and p′, an anisotropic substance gives no evidence of its doubly refractive nature.

However, if the doubly refractive substance is in such a position that neither of its planes of vibration p and p′ is in alignment with that of the polarized light coming from the polarizer, the vibrations are resolved into two different planes c and c′. These vibrations pass through the material and emerge from it, each vibrating differently, and since neither of these planes is exactly "crossed" in respect to the analyzer, the light is partially transmitted and the specimen appears light.

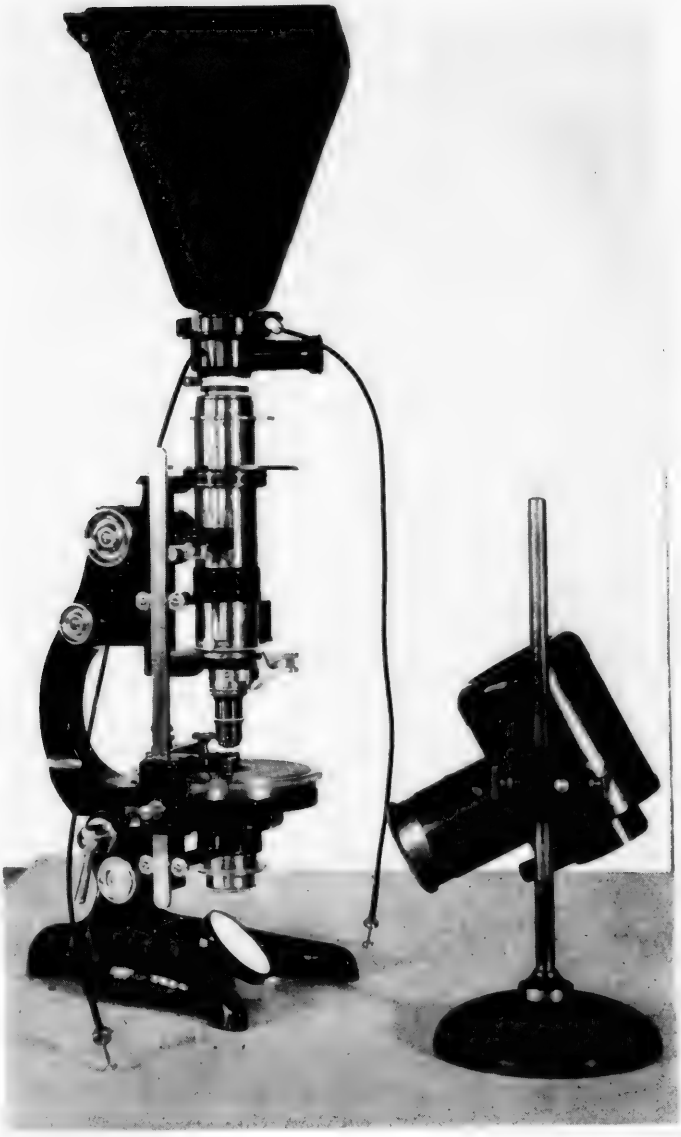


FIG. 6

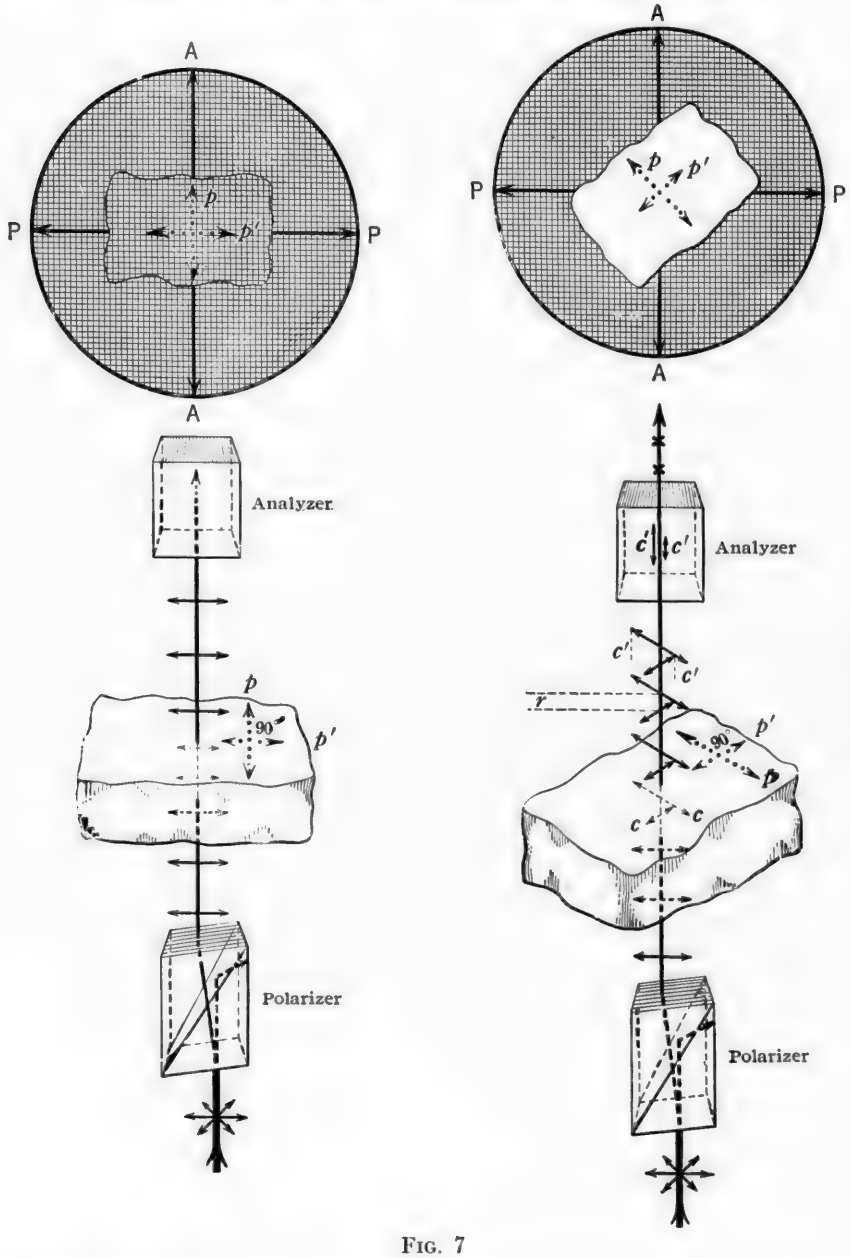


FIG. 7

Handbook of Chemical Microscopy, Vol. I. Chamont and Mason, John Wiley and Sons, Inc., New York.

The use of polarized light as a means for the identification of material has largely been limited to minerals until recent years. So specialized has been this application that polarizing microscopes are described as petrographic. Recently, however, the technic has extended into fields as diversified as ceramics, sugar refineries, textiles and the manufacture of chemicals and drugs.

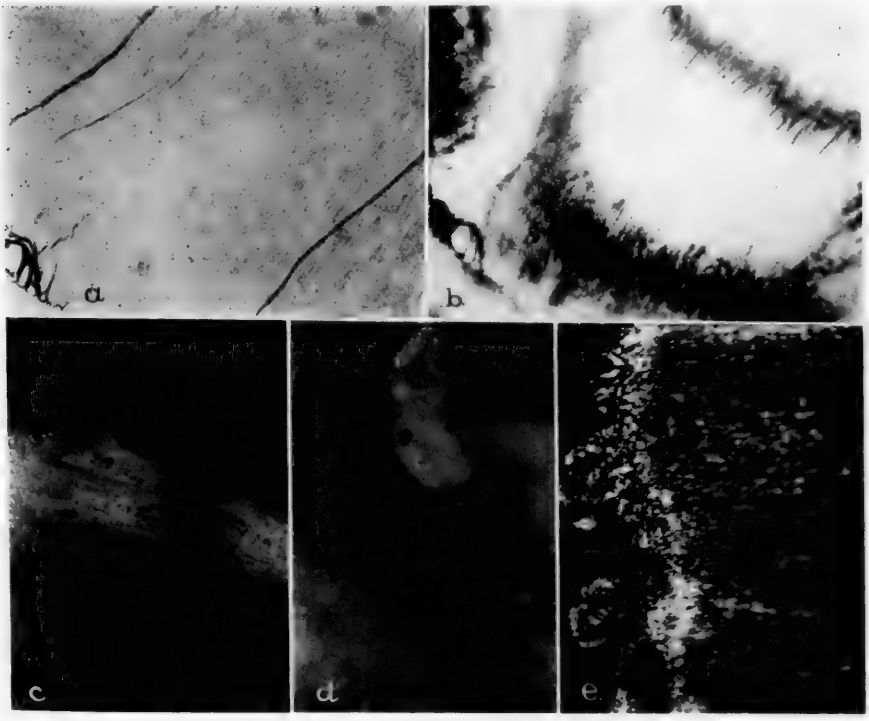


FIG. 8

A very promising and almost unknown field of application of the polarizing microscope is in the investigation of plant and animal tissues. Characteristic structures and variations which are otherwise imperceptible are revealed without any alteration of the specimen and may be observed even in the living material. The early biologists evidently used polarized light in the examination of biological subjects, but their observations have passed unnoticed until recently. This seeming negli-

gence may have been due to a lack of correlation between the early observations and the present known biological phenomena.

Let us consider a few applications which may hold promise for further scientific investigations.

Kitchin and Cape (1930) postulated that the susceptibility of enamel areas of teeth to acid attack may be due to actual differences of the chemical composition of the enamel. A section of tooth with ordinary technical methods (Fig. 8a) and illumination reveals little structure except the faint striations of the enamel rods. However, between crossed Nicol prisms definite structural and chemical differences become apparent (Fig. 8b). The outer enamel is definitely of sounder structure than the inner portion.

Recent research in endocrinology has directed interest to the mammalian ovary. This organ contains two types of cells which appear identical in morphology but differ in their respective origins. Under the ordinary microscope these differences can be determined only by complicated staining and solubility tests. A fresh, untreated, frozen section reveals little structure (Fig. 8c), but between crossed Nicol prisms the author was able to show definite histochemical differences of the fatty inclusions (Fig. 8d).

The characteristic arrangement of the lipoids in the three zones of the adrenal gland presents an interesting study and possibility (Fig. 8e).

Voluntary muscle as revealed by ordinary staining methods is composed of alternate dark and light bands. Through the middle of the dark band is a fine light line (Krause's line), and an even thinner dark line may be seen running through the larger light band (Hensen's line). Without any technical treatment a fresh preparation of voluntary muscle by polarized light will reveal the same characteristics but with better definition.

The most significant application of polarized light to histology is the study of degenerating nerves. Virchow (1854) and other workers have reported that the myelin sheath of nerves showed birefringence, but apparently no application of this principle of the study of degeneration was made. With polarized light alone Setterfield and Sutton (1935) demonstrated intricate cellular detail, such as neurofibrils, nuclei of Schwann cells, node of Ranvier, incisures of Schmidt-Lantermann, and globules of degenerating myelin. Technical methods have proved inaccurate, misleading and not sensitive to the earliest stages of degenera-

tion. By the Marchi staining method degeneration cannot be diagnosed until three days after the severing of the nerve. Thus it is quite evident that a much more sensitive method is needed if the earliest stages of neural degeneration, as well as the details of its progress, are to be studied. The method should not depend upon artefacts produced by staining technic but should make use of such unaltered chemical and structural

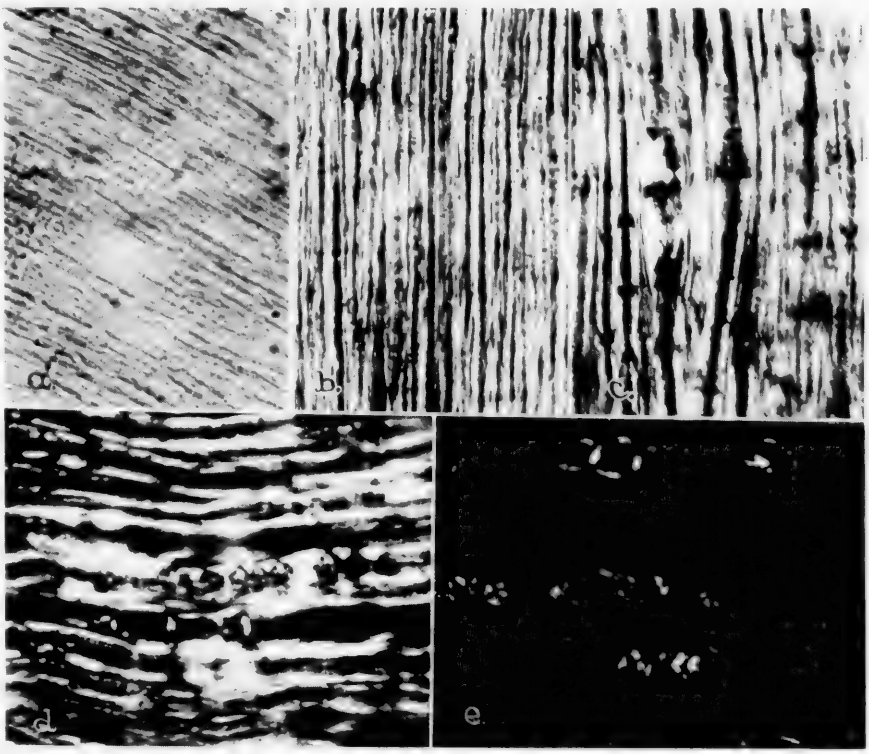


FIG. 9

changes as have actually occurred at the time of observation. Polarized light offers a method of observation which does not depend upon the artefacts of specimen preparation.

A fresh, unchemically treated, frozen preparation of a normal nerve with ordinary illumination presents a striated appearance without definition (Fig. 9). With polarized light individual nerve fibers are now apparent, the nerve sheath being white and the axis-cylinder dark.

Degeneration can be demonstrated as early as an hour-and-a-half after the severing of a nerve; in three hours the fibers are greatly swollen and the myelin is definitely broken into masses. At three days, the time when degeneration is first visible with staining technics, the process is approaching termination.

Observations made with polarized light can be recorded only by photomicrographs, as the tissue specimens cannot be preserved. In preparing material for study it is only necessary to mount teased or frozen sections in glycerine under a cover glass. If the specimen is too soft and friable, it may be immersed in 10% formalin for 24 hours. The formalin immersion for this length of time does not change the appearance of the tissue.

The camera may be an attachable model, as already shown, or it may be of a sturdier build. The illumination is from a 500 watt unit. Wratten M plates seem to give better contrast than any other type. The exposure varies from 1 to 4 minutes, depending upon the thickness of the preparation. It must be remembered in estimating the exposure time that only a small portion of the light is transmitted through the specimen, i.e. only the light vibrating in a particular plane. Development in Eastman X-ray developer is the same as usual.

In recent times we have seen considerable application of illumination methods in the biological sciences. X-ray and ultraviolet need no mention. Infrared presents many possibilities, but with polarized light not even the surface has as yet been scratched. It seems quite feasible to prophesy that in the next few years methods of illumination will become more and more valuable means of investigation and that they will contribute much to biological research.

BAIRD, T. T.: Cytological Study of the Corpus Luteum and Interstitial Gland of the Pregnant Rabbit. Thesis, Ohio State University, Columbus, Ohio, 1931.

CAPE, A. T. AND KITCHIN, P. C.: Histological Phenomena of Tooth Tissues as Observed under Polarized Light, with a Note on the Roentgen Ray Spectra of Enamel and Dentin. Jour. Amer. Dent. Asso., **17:** 198, 1930.

CHAMOT, E. M. AND MASON, C. W.: Handbook of Chemical Microscopy. Chapman and Hall, London, 1930.

KIMBALL, A. L.: Textbook of Physics. Henry Holt and Co., New York, 1917.

PIERURA: Lectures on Polarized Light. Longman, Brown, Green and Longman, London, 1843.

SAUNDERS, F. A.: A Survey of Physics. Henry Holt and Company, New York, 1930.

SETTERFIELD, H. E. AND BAIRD, T. T.: Polarized Light as a Supplement to the Marchi Method. Stain. Tech. **2:** No. 2, 1936.

SETTERFIELD, H. E. AND SUTTON, T. S.: The Use of Polarized Light in the Study of Myelin Degeneration. Anat. Rec. **61:** No. 4, 1935.

DISCUSSION OF MISS BAIRD'S PAPER

MR. KIEFFER reported that, although Miss Baird recommended a special research microscope for work with polarized light, he had had satisfactory results in studying pulmonary diseases by polarized light on an ordinary microscope. He said it was a very useful method, as in studying conditions in diseases due to industrial dusts ordinary light makes visible only a small percentage of what polarized light reveals.

MISS BAIRD answered that certain observations could certainly be made by polarized light on an ordinary microscope but in dentistry, for instance, or in any problem where complicated crystalline structures are involved, it is necessary to have a research microscope.

MR. ZIELER made the following comments on the two types of microscopes:

"Although the biological microscope can be equipped with a polarizer and an analyzer, there are various requirements in using polarized light for microscopy which make it advisable to select a special type of microscope.

The most essential requirement for a microscope for polarized light is a rotating object stage. Wherever polarizing effects are to be observed, one ought to be able to rotate the object to see if there is extinction when the vibratory directions of the polarizing (anisotropic) specimen coincide with those of polarizer and analyzer. Without a rotating object stage investigations in polarized light are practically impossible.

It is advisable to have this rotating stage equipped with graduations in degrees and possibly with a vernier to make definite measurements of the angle of extinction.

It is furthermore evident that if there is a rotating stage there should be some means to bring the axis of rotation of the stage into coincidence with the optical axis of the microscope. If this is not the case the specimen, upon being rotated, will move outside the field of view. The required conditions can be obtained in two ways, viz., (a) the stage can be equipped with a centering device; (b) the objectives can be equipped with a centering device. The latter method is to be preferred. It is never possible to make a multiple nosepiece for a microscope so accurate

that in swinging from one objective to the next the optical axis is accurately maintained. Thus if the stage is centered for one objective and is then changed to another, it becomes necessary to recenter the stage. If, however, the microscope is equipped with a clutch and each individual objective is held in a centering ring, one can once and for all center the entire optical equipment of the microscope to the axis of the stage, and in changing from one objective to another the matching of the axis of rotation of the stage and the optical axis of the microscope will be maintained.

The apparatus for illumination likewise has to fulfill definite specifications. One fact which makes observations in polarized light so valuable is that the polarizing effects depend upon the direction of light penetrating the specimen. Therefore, for regular observations one should have light of only one direction, or, in other words, parallel light. The substage of the biological microscope is equipped with a condenser which concentrates the light. The polarizing microscope has a single lens low power condenser with a polarizer below, and it also has a special aperture diaphragm which is in the correct plane for this low power condenser. The substage of the biological microscope has the diaphragm in the plane of the entire condenser system but if the top lens of this condenser system is removed, this iris diaphragm is no longer in the correct plane to control the aperture of illumination. There is another type of observation to be made with the polarizing microscope where it is essential to pass a cone of light through the specimen in order to observe the interference figure in the plane of the back lens of the microscope. Thus the substage of the polarizing microscope has a special condenser system in swingout mount. This system creates a high concentration of light in the plane of the specimen, which is necessary for the observation of interference figures. When such figures are observed, it is either necessary to remove the entire ocular from the microscope (in which case one looks directly into the plane or the back lens of the objective) or to insert into the tube a so-called Bertrand lens which, with the eyepiece, forms an auxiliary microscope to observe the plane of the rear lens of the objective.

In regard to the question whether a tube analyzer or a cap analyzer is preferable, it must be remembered that the tube analyzer is not limited by magnification of the eyepiece whereas the cap analyzer can only be

used for eyepieces of low magnification. On the other hand, the tube analyzer is more expensive and requires special correction lenses."

MR. FUCHS followed this discussion with lantern slides and a motion picture made with the Eastman Pola-Screens, which employ the polarizing principle. The introduction of an efficient plane polarizing sheet material in sizes large enough to cover lenses and lights has made simple the use of polarized light in photography. An Eastman Pola-Screen incorporating this material, over the lens, allows unusual sky effects, photographing obliquely through glass and water without reflections, and photographing other surfaces obliquely to show surface detail. When the subject is illuminated through larger Pola-Screens in addition, complete control of gloss results. Faces so photographed can appear unnaturally perspiry, or devoid of all luster, depending upon the camera Pola-Screen position. Reflections from animation cells can be greatly reduced, and photographing any small object that presents a reflection problem is quite simple. Various trick lightings and color-effects are also attainable.

For further information regarding this subject, reference should be made to the article, "Introduction to the Photographic Possibilities of Polarized Light" by F. Tuttle and J. W. McFarlane, *Jour. Soc. Motion Picture Eng.*, **25:** 69–78, July, 1935.

DIRECT PHOTOMICROGRAPHIC HALF-TONE NEGATIVES FOR COLOR REPRODUCTIONS*†

OSBORNE O. HEARD

Baltimore, Md.

Various methods of color photography have been applied by photomicrographers for the reproduction of histological preparations. Usually "screen plates" or "colored transparencies" are produced and submitted to the photo-engraver for copying. In 1925 the author[1] adapted a 175 line half-tone screen to the back of a large Bausch & Lomb Optical

* From The Department of Embryology, Carnegie Institution of Washington, Baltimore.

† Received for publication July 16, 1936.

[1] HOEN, A. B., AND HEARD, O. O.: *Demonstration of direct color photomicrography for reproduction of histological preparations.* Anat. Rec., vol. 32, p. 246. 1926.

Company horizontal photomicrographic apparatus and demonstrated the feasibility of making color separation and half-tone negatives direct from histological preparations for color reproductions. Later Mr. A. B. Hoen, of A. Hoen & Company, lithographers, transferred a set of negatives to stone, from which reproductions were made.[2]

It was found that a considerable loss of fine detail occurred when these negatives were transferred and inasmuch as the cost of color reproductions was then relatively high for scientific purposes and the field of application limited, the method was never published. Now that colored reproductions are generally met with in low-cost publications, the method has been revived and given fresh impetus in the hope that its use may aid in the more exact presentation of histological and minerological preparations.

METHOD

The modified photomicrographic camera back, figure 1, was designed to hold the half-tone screen so that it could be adjusted accurately in relation to the sensitive plate and rotated for the proper screen angles. A frame was built and fitted nicely to the back of the bellows support after the standard plate holder and focusing screen frame had been removed. It was found that the usual plateholder kit was too thick; therefore a circular metal mask was made and fitted with reenforcing strips to accommodate a 4″ x 5″ plate. This holder was fastened in the back and three small holes were drilled beyond the margin of the mask over which cleared film was cemented. On the cleared film cross lines were ruled for registration. These furnished means of registering the plates when printing. Such an arrangement yields uniform register lines, providing the holder and microscope with the object are held perfectly stationary throughout the making of the series of plates.

To allow for freedom of movement the holder, figure 2, for the half-tone screen was made slightly smaller than the inside dimensions of the frame which supports the plateholder. A rack and pinion adjustment for the setting of the screen was built into the base of the frame and holder, and a pinion shaft was extended through the plateholder frame. An indicator scale, ruled in 0.1 mm., and a knob on the shaft were

[2] STREETER, DR. G. L.: *The "Miller" Ovum—the youngest normal human embryo thus far known.* Carnegie Inst. Wash. Pub. No. 363, Contrib. Embryol. No. 92, vol. 18. 1926.

placed on the outside of the frame to facilitate the adjustment of the screen distance. The rotating member of the screen support was held in position by an offset in both frame and disc. The disc was held in place by three phosphor bronze springs. The circumference of the rotating member, which holds the screen, was graduated in the four degrees usually employed in color work.

Since the work was of an experimental nature, only essential parts of the regular half-tone screen back were constructed and it was found

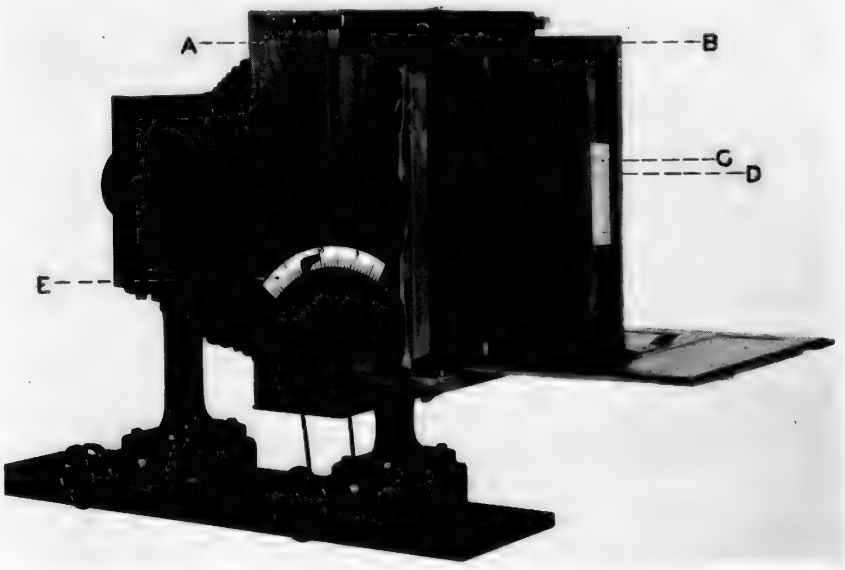


FIG. 1. Half-tone screen back adapted to a Bausch & Lomb Optical Company GG3 photomicrographic stand. *A*, bellows and plate holder support; *B*, frame for half-tone screen support; *C*, metal mask and 4″ x 5″ kit; *D*, registration marks and *E*, scale for measuring screen distance.

that in rotating the screen it was necessary to remove the back and adjust the screen for the exact angle and replace it before each exposure. Metal dowels were fitted in the plateholder frame to prevent any displacement when this was done. Since the apparatus was set up in a dark room, it was unnecessary to slip out the plateholder and its mask. It may be noted here that it would not be necessary to remove the back when making a half-tone negative for monochrome printing as the screen could be set at the normal angle of 45°.

The adjustment of the screen, in relation to the sensitized emulsion of the panchromatic plate, is a critical operation which calls for the application of the rule of screen distance, stop, etc., as used in photomechanical practice. This rule may be briefly stated as follows: "The ratio of the camera extension to stop diameter equals the ratio of screen distance to screen opening." This rule is applicable if we consider the

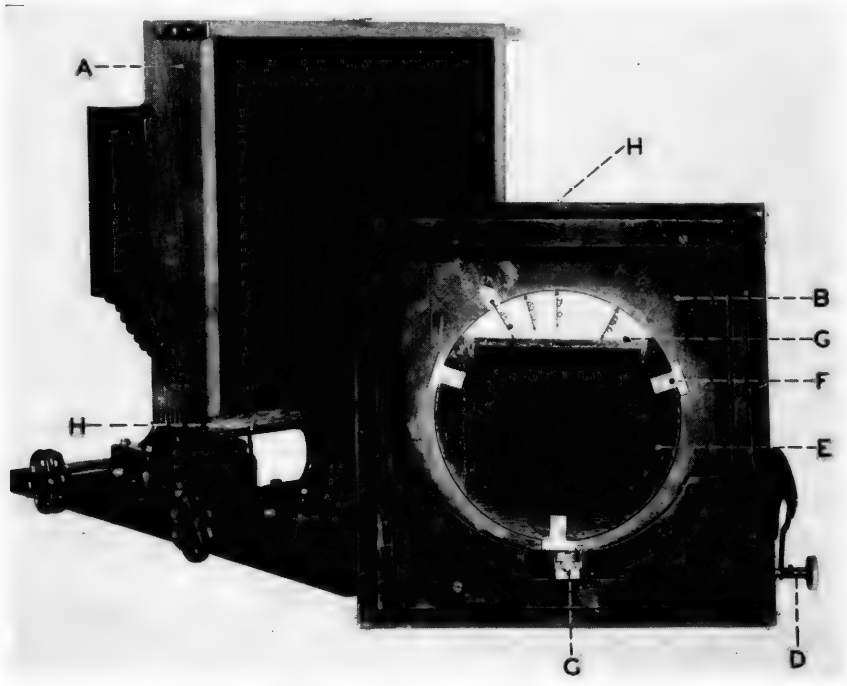


FIG. 2. *A*, bellows and plateholder support; *B*, holder for half-tone screen; *C*, rack and pinion; *D*, pinion shaft and adjusting knob; *E*, rotating member for half-tone screen; *F*, phosphor bronze spring; *G*, scale for measuring screen angles, and *H*, metal dowels.

aperture of the eye lens in the ocular of the microscope comparable to the stop in the lens in the photo-engraver's camera. The stop of the copying lens is adjustable whereas the aperture in most oculars is fixed and, since the camera extension in both cases is fixed for definite magnifications or reductions, the photomicrographer has but one adjustment to make, viz., screen distance. This screen setting cannot be done

empirically unless one is an experienced photo-engraver and accustomed to half-tone dot rendering; therefore it is imperative that either the ratios expressed above or the Liesegang diffraction formula $\frac{d^2}{3\lambda}$ be applied.* This formula should be employed when fine screens are used.

In using the Liesegang formula, it is found that d equals the screen opening and λ the wave length of the light by which the plate is being exposed. We may then construct a table for a 175 line screen and for the four Wratten & Wainwright filters used in four color work as follows:

$$\#11 \quad X1 \quad \frac{d\ .0715\ \text{mm.}^2}{\lambda\ 500\ \text{m}\mu\ 3} = 3.33\ \text{mm. distance of screen ruling from emulsion}$$

$$\#25 \quad A \quad \frac{d\ .0715\ \text{mm.}^2}{\lambda\ 650\ \text{m}\mu\ 3} = 2.56\ \text{mm. distance of screen ruling from emulsion}$$

$$\#58 \quad B \quad \frac{d\ .0715\ \text{mm.}^2}{\lambda\ 540\ \text{m}\mu\ 3} = 3.08\ \text{mm. distance of screen ruling from emulsion}$$

$$\#47 \quad C5 \quad \frac{d\ .0715\ \text{mm.}^2}{\lambda\ 460\ \text{m}\mu\ 3} = 3.6\ \text{mm. distance of screen ruling from emulsion}$$

Knowing the thickness of the cover-glass on the half-tone screen and that the optical path will be shortened by about one-third the thickness of the cover-glass, this amount is deducted from the screen emulsion distance to obtain the exact setting for the screen.

It was found in practice that the range of ratios exceeded those of most commercial work. This range is from 64 to 90. The colored Plate I was taken with a ratio of 53.8. A decrease in the ratio is permissible providing the cover-glass on the half-tone screen is thin enough. Low ratios were met when using the large aperture Zeiss Homal. The II Homal has an aperture of 40 mm. and the remaining four of the series have varying apertures which average 14 mm. in diameter. The greatest magnification obtainable with a II Homal using a 175 line screen with a 1 mm. cover is approximately $\times$ 200. At this setting the cover-glass of the screen would be in contact with the emulsion on the plate.

* I wish to express my appreciation to M. Alex Murray of the Research Laboratories of Eastman Kodak Co. for supplying the Liesegang formula.

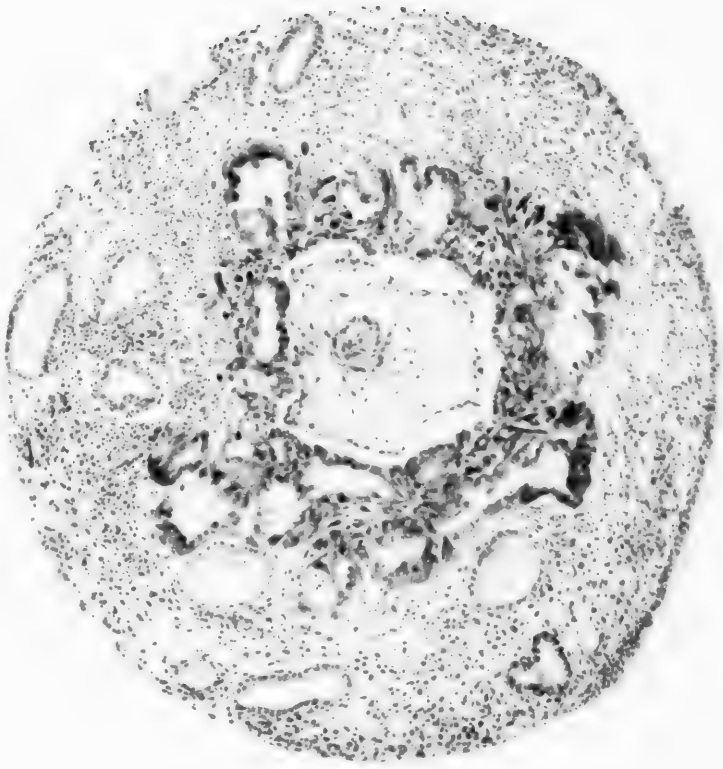
PRACTICAL CONSIDERATIONS

The colored photomicrograph in Plate I was made under the following conditions. The Bausch & Lomb Optical Company's GG3 photomicrographic stand was mounted on rubber to absorb vibration. The light source was a General Electric Mazda lamp with vertical filament 18 amperes, 6 volts mounted in an appropriate housing with an adjustable aspheric condensing lens. Critical illumination was obtained by focusing the image of the filament in the plane of the object. The substage condenser was a 1.4 Aplanat and the diaphragm was set at 5 mm. A 16 mm. apochromatic objective and a × 8 Periplane ocular were used to form the image. The object was photographed through the inverted slide so that the finished reproduction appeared erect. (Inserting a 45° prism in the converging beam would serve the same purpose but this would necessitate the making of radical changes in the present set-up. This change would be imperative if a 4 mm. or shorter equivalent focus objective were used, as the working distance would be too small to allow focusing through the average slide.) The camera extension was 32.35 cm. and, since the working aperture of the ocular was 6 mm., the ratio (R) was 53.8.

Since the screen opening of a 175 line screen is 0.0715 mm. and the ratio 53.8, it follows that the screen distance should be 3.85 mm.; and since the thickness of the cover-glass on the screen was 1 mm. and the amount of diffraction one-third the thickness of the cover, therefore the actual distance of the face of the screen to the emulsion was 2.5 mm.

Wratten & Wainwright M plates were used and the A–B–C5 and X1 filters. The exposures varied from $\frac{1}{1\frac{1}{2}}$ to 1 second. The factors given for tungsten light were 3.8 for A, 6 for B, 11 for C5 and 3 for X1. The A or blue printing plate was overexposed but serviceable without reduction. Some modification for the listed factors would have to be made to obtain a set of negatives of uniform density. This would be influenced by the light source. All of the negatives were developed at 65° in D9 for 2 minutes with the exception of the C5 negative which was given 30 seconds longer development.

The negatives were submitted to Mr. Edward L. Anderson of the Standard Engraving Co. of Washington, D. C. along with the specimen and a microscope. This served in place of the usual "copy." The half-tone copper prints were flat etched and reetched to increase the relative tone values. The amount of handwork was very slight.



THE "MILLER" OVUM ×75

Reproduced by Photomicrography Direct from Specimen

Photomicrographer, OSBORNE O. HEARD

Engraved Plates by
THE STANDARD ENGRAVING CO.
Washington, D. C.

Printed in Three Colors by
CASLON PRESS
Washington, D. C.

UNIV. OF MICH.

Nothing was added or taken away from the detail in the finished reproduction. A departure from the four-color method was necessary since there were no blacks in the preparation. Three colors were used in printing and the resulting reproduction appeared strikingly like the preparation. The color separation, sharpness of detail and registration of the reproduction proved to be excellent. It was felt that the clean and crisp quality of the finished colored plate was primarily due to the direct method employed. All photographers are aware of the loss of finest detail when printing; at each transfer from negative to paper, film or glass, something of the original is lost, slight though it may be.

I wish to express my thanks to Dr. Frank F. Bunker of the Carnegie Institution of Washington for making the necessary arrangements with the Standard Engraving Co. of Washington, D. C. for the carrying out of the photomechanical work. I also wish to thank the staff of the Standard Engraving Co. and particularly Messrs. Anderson, Barthelmess and Stulz whose interest and skill materially aided in making the experiment a success.

SURGICAL MOTION PICTURES WITH 16 MM. TYPE A KODACHROME*†

HARRIS B. TUTTLE AND HAROLD J. HENN

Rochester, N. Y.

At the convention of your Society held in Chicago last year, the senior author had the privilege of reading a paper telling about the use of the new Kodachrome film in the making of medical motion pictures. In that paper it was pointed out that there was still much to be hoped for, and that with more extensive use of the new medium further improvements unquestionably would be made.

The object of this paper is to bring to you all new information available concerning the advances made in this field in technic, improved materials and apparatus since the Chicago meeting.

The latter part of last year the Eastman Kodak Company announced a new magazine type of 16 mm. movie camera called the Magazine Ciné-

* From the Eastman Kodak Company.

† Read at the 1936 Convention of the Biological Photographic Association.

Kodak. (Fig. 1.) This new camera loads with a light-tight film chamber or magazine holding 50 feet of film. The magazine can be inserted ready for use in three seconds. The film is completely threaded within the magazine so that once it is placed in the camera and the door locked it is ready for exposure. Magazines containing Eastman Kodachrome, Panchromatic or Super-Sensitive film are regularly supplied.

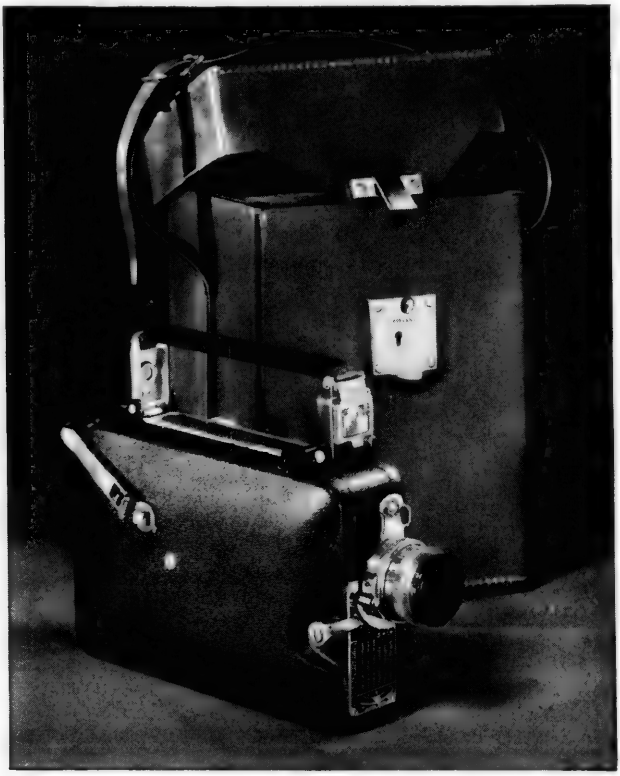


FIG. 1. Magazine Ciné-Kodak

It is possible to change from one magazine to another or from one type of film to another without fogging a single frame of film. This is made possible by a new type of sliding key which, when drawn to lock the camera door, automatically opens the protective shield over the film aperture. When the sliding key is moved to unlock the camera door the protective shield is again drawn over the film aperture, thus pre-

venting the fogging of a single frame of film, even though the magazine be changed when a roll is only partly exposed.

The camera is regularly equipped with a one-inch lens which is interchangeable with the 2, 3, $4\frac{1}{2}$, and 6-inch telephoto lenses.

The camera can be operated at three speeds, 8, 16 and 64 frames per second.

The extremely short time required to change magazines, the interchangeable lens feature and the three camera speeds make it an excellent camera for use in medical photography.

The Ciné-Kodak Special announced by the Kodak Company two years ago and demonstrated before this Society at the convention held in Rochester is a good 16 mm. movie camera for medical work. (Fig. 2.) Many medical photographers are using both the Ciné-Kodak Special and the Magazine Ciné-Kodak on important operations, the Ciné Special on a tripod with telephoto lenses where steadiness and extremely close view are required to show fine detail, and the Magazine Ciné-Kodak for longer views and general cut-in shots. Either camera alone will produce excellent results; the two if used together provide an ideal combination of camera equipment.

Several new attachments have been designed for the Ciné-Kodak Special of particular usefulness in the medical field. Chief among these attachments is the motor drive and time lapse control device. (Fig. 3 and Fig. 4.) With this electric control the film may be run continuously at any speed from 64 frames a second down to one frame a second, and intermittently from one frame a second to one a minute, hour, day, or week with the hand electric remote control switch, which in turn may be attached to a clock for accurately timing the intervals.

It can be used on either direct or 25 to 60 cycle alternating current, 100 to 125 volt lines. The motor is controlled by an electric governor. The camera is attached to the motor drive base, and the entire unit can be used on the Ciné Special tripod.

A special nonsparking synchronous motor with nonsparking foot switch for 60 cycle current is available and because of its safety is recommended for use in the operating room.

With the motor drive plus the interchangeable magazine the Ciné Special can be operated almost continuously, thus avoiding the loss of valuable bits of action, which sometimes happens when one has to stop

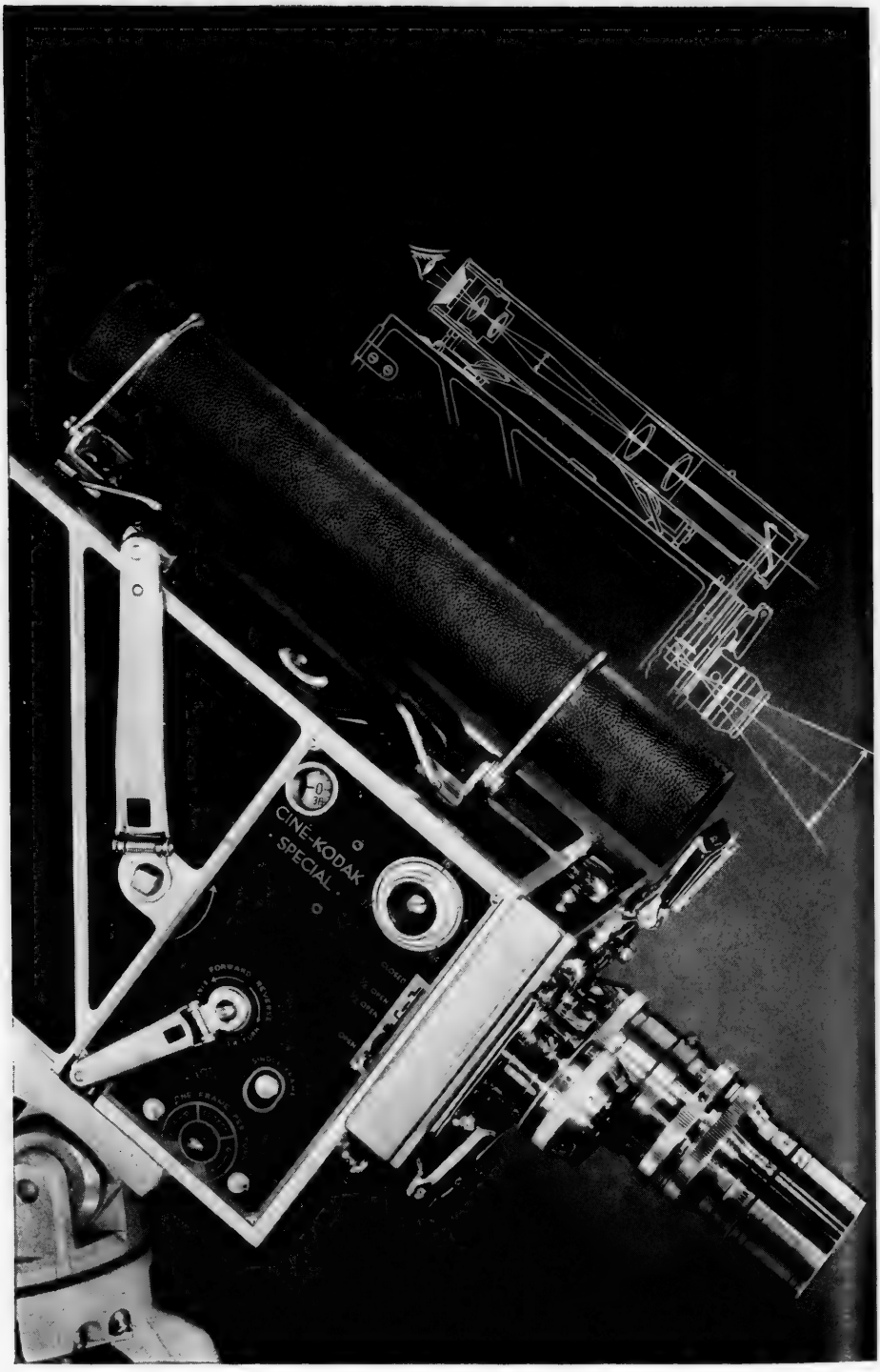


FIG. 2. Ciné-Kodak Special

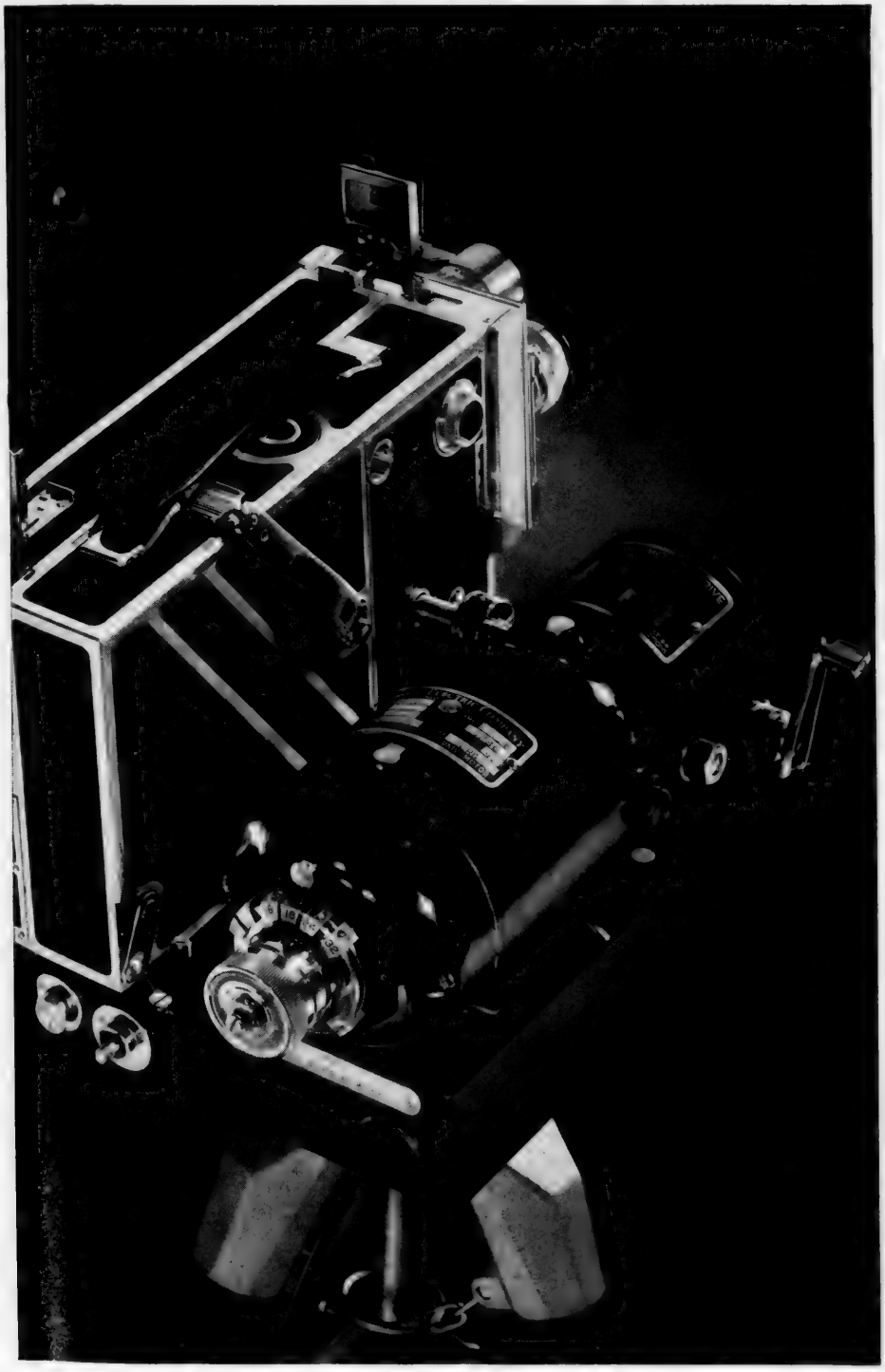


FIG. 3. Ciné-Kodak Special and Motor drive unit

to rewind or reload. The electric remote control attachment is particularly useful in filming of bacterial growth under the microscope.

Two new features added to the latest models of Ciné-Kodak Special are the frame counter and audible signal. The frame counter enables

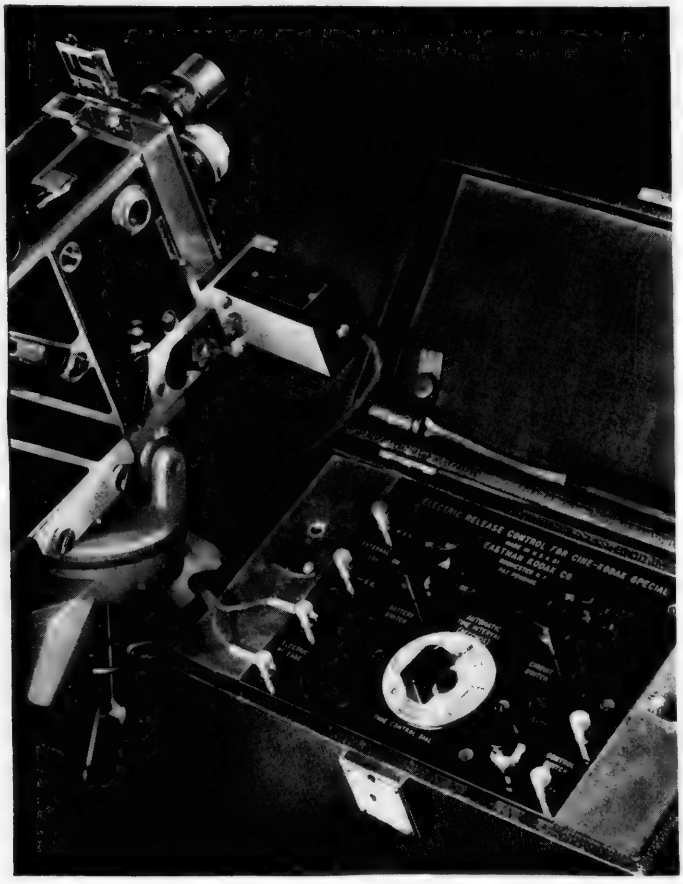


FIG. 4. Ciné-Kodak Special and electric release control

the camera operator to accurately return to any given frame in multiple exposure work, and an audible signal sounds when the camera is started with the shutter closed.

Another new piece of equipment is the Ciné-Kodak Tripod Truck. (Fig. 5.) The truck consists of a triangular shaped frame supported on

three rubber covered wheels. The camera on the tripod can be moved about at will for making follow shots.

Probably the most significant improvement has been in Kodachrome film. Last spring a new film called Type A Kodachrome film for use with artificial light was placed on the market by the Eastman Kodak Company.

FIG. 5

The announcement of this new film is of particular importance to those using artificial light in the making of medical films either of a clinical, surgical or a pathological nature.

Heretofore to obtain satisfactory exposures the medical photographer has been obliged to use regular daylight Kodachrome film with a blue artificial light compensating filter in order to obtain satisfactory color rendition. The filter factor which was about 4x, or two diaphragm stops, limited materially the extensive use of Kodachrome in medicine and surgery. Now pictures can be made on the new Type A Kodachrome with artificial light just as easily as in daylight with regular Kodachrome film.

In making movies in Kodachrome we have two general types of light to deal with, the natural outdoor daylight from the sun and artificial light. Both types of light have very definite color characteristics. The color value of daylight depends not only upon the time of day and time of year, but on the condition of the sky and atmosphere. So, while regular Kodachrome film is fundamentally a daylight film, it is balanced for noonday sunlight. However, pictures made on it any time between nine o'clock in the morning and four o'clock in the afternoon are satisfactorily rendered. Before nine and after four the sun's rays are much redder and therefore pictures made before or after these hours appear slightly reddish on projection.

Artificial light also varies in its color, depending upon its source and temperature. For instance, tungsten lamps, Photofloods, Neon lamps and carbon arcs are all different types of artificial light, yet each differs in its spectral color characteristics.

Arc lamps vary in color depending upon their temperature and the type of carbon used. With white flame carbons, for instance, the color emitted is very similar in its spectral characteristics to noonday sunlight. With light of this type regular daylight Kodachrome film should be used rather than the new Type A film.

Regular tungsten filament lamps burning at their rated voltage are quite red when compared to sunlight, and resemble somewhat early morning or late afternoon sunlight in color.

Photoflood lamps are overvolted tungsten filament lamps and burn at a higher temperature than regular tungsten lamps, therefore they emit more blue radiation. In spite of this, however, their color is still reddish when compared to noonday sunlight.

To manufacture commercially an artificial light film, it is obvious that it can be made to accurately match only one type of light source burning at a definite temperature. Since Photoflood lamps are efficient and economical and are most generally used, the Type A Kodachrome film is manufactured to color balance with these lamps. While pictures made on it with regular tungsten filament lamps will be quite satisfactory, the critical color photographer will note a tendency toward ruddiness due to the excessive red in regular tungsten. This ruddiness is not serious if new lamps are used and burned at their proper voltage, or if regular tungsten lamps are slightly overvolted.

Since this new Type A film is extremely blue sensitive it is obvious

that every precaution must be exercised to exclude all daylight from the subject. If daylight is present, the resulting pictures may show a duocolor effect—the highlights and middle tones will be correctly rendered but the shadows may reflect the daylight and photograph quite blue. Many operating rooms have north sky light and, since the light reflected from the north sky is much bluer than sunlight, it becomes all the more important to exclude as much as possible of it from the operating room. This duocolor effect can be partially corrected by the addition of one or two Photoflood lamps for general illumination of the shadow area surrounding the more brightly lighted operative field.

It can be seen from this data that if the new film is used in daylight the resulting pictures will predominate in the blue, as regular Kodachrome predominates in the red when exposed in artificial light without the blue filter. For those who may want to use the new artificial light film in daylight it will be necessary to use a light orange filter to obtain the proper color balance.

The new Type A Kodachrome is similar to regular daylight Kodachrome in its exposure characteristics, namely, that the exposure must be judged fairly accurately to obtain the best results and also the subject contrast must be kept low by using a soft or flat lighting. The film is much more sensitive than the human eye in registering slight differences in light and shade or in shades of color. A contrasty lighting commonly employed for black and white pictures is not suitable for color photography. A contrasty lighting accentuates the natural tone and color contrast of the subject beyond the film's ability to faithfully reproduce the extreme light and dark tone values.

The automatic printing used in the reversal process for black and white films is not applicable in the processing of Kodachrome film, therefore overexposed pictures will be light in appearance on the screen while underexposures will appear too dark. The film, however, does have sufficient latitude to allow an error of about one-half to one diaphragm stop more or less than the correct exposure. In other words, for a flatly lighted subject of average contrast, where a lens stop of f:5.6 would be the correct exposure, f:8 would render a dark or slightly dense positive, and f:4 would render a light, more pastel version of the picture. Two stops either way from the correct exposure render pictures definitely on the over or under side in exposure.

The following exposure guide if carefully followed will give very satisfactory results:

Exposure guide for Kodachrome artificial light film

Type A with Eastman Kodaflectors
Normal camera speed

f:1.9	f:2.8	f:3.5-4
2 lamps at 5½ feet	2 lamps at 4 feet	2 lamps at 2½ feet
3 lamps at 7½ feet	3 lamps at 5 feet	3 lamps at 3½ feet
4 lamps at 8½ feet	4 lamps at 5½ feet	4 lamps at 4 feet

Four lamps at 4 feet will satisfactorily illuminate about 20 square feet at f:3.5, or at 8½ feet above 40 square feet at f:1.9.

It must be kept in mind that the number of lamps recommended above is for the illumination of limited areas. Likewise, the guide is for the use of Eastman Kodaflectors with the Photoflood lamps. It is important to always measure the distances of lamps from the subject before making an exposure.

Dented and dusty reflectors, badly blackened lamps and low line voltage all contribute toward cutting down on exposure. If one is aware that any of these factors is present some compensation should be made by allowing slightly more exposure than the chart indicates (one-half to one stop larger).

Usually when we illuminate a subject our first impulse is to throw all of the light from our lamps on to the light colored areas. This is wrong. The bright spot of light from the reflectors should be directed into the shadows or darker tones. The outer band of diffuse light from each lamp when overlapped is of ample strength to illuminate the lighter tones such as flesh tints. This also helps to reduce subject contrast and give a flat, even lighting.

One way of lowering subject contrast is to use an extra pair of Kodaflectors with Photoflood lamps to illuminate the background immediately behind the subject. The background and other details in a picture should receive as much consideration in lighting as the subject to produce the most pleasing results. This is helpful in the filming of clinical subjects and gross specimens.

It is possible to obtain satisfactory pictures with only two ordinary 100 watt, 110 volt tungsten lamps. Such lamps can be placed in flexible gooseneck desk lamp reflectors or Kodaflectors and placed at 2½ feet from the subject (one on each side) and exposures made at f:1.9 normal

camera speed. These two lamps will illuminate an area of between three and four square feet, and can only be used for extremely close-up views.

In surgical photography it has been found possible to make pictures of operations using the regular operating room lamps at a diaphragm of f:1.9. If an auxiliary 500 watt, 110 volt spotlight is employed exposures can be made at f:3.5 to f:4. This makes it possible to utilize the longer focal length lenses such as the 2, 3 and 4½ inch telephoto lenses. If a 500 watt, 100–105 volt lamp is used in a spotlight, a slightly smaller lens diaphragm can be used and the slight overvoltage will give improved color rendition.

Inasmuch as the illumination of the regular operating room varies considerably in the various hospitals, the above information may not be universally applicable. In order to determine the correct exposure in any hospital for fixed light sources, an exposure test should be made under operating conditions. When filming laboratory specimens or clinical subjects with Kodaflectors and Photoflood lamps, the exposure table given here is reliable. Since we are usually more critical of color rendition in medical photography than in personal pictures, it is important that such pictures be exposed as correctly as possible. The delicate flesh tints become pale with overexposure and dark, with loss of shadow detail, when underexposed. The presence of excessive blue daylight will cause the tones to appear still further distorted in color.

To summarize briefly: The new artificial light Type A Kodachrome film is balanced for Photoflood lamps, but will also render satisfactory results with new or slightly overvolted regular tungsten filament lamps. For white flame carbon arcs the regular daylight Kodachrome film should be used. Since the new film is extremely sensitive to blue, care must be exercised to exclude daylight from the room. The exposure guide in this article is for use with Photoflood lamps when used in Kodaflectors.

In the past year thousands of rolls of Kodachrome film have been exposed on medical subjects. Foremost in the field is the Davis and Geck Company, who have undertaken the making of a series of surgical pictures in Kodachrome to be loaned for showing before medical groups.

Many medical schools have already started on a program of Kodachrome pictures. All of this activity is conclusive evidence of the

interest and need for good color films for lectures, teaching and general records.

Several insurance companies through their medical advisers are making Kodachrome records of accident cases that may subsequently be fought out in court.

New uses are constantly being found for medical films in color. The possibilities of films on hygiene for general use in schools and in public health clinics have not been explored but offer great promise. The extent of our imagination is perhaps the only limit to the applications of Kodachrome in medical photography.

APPLICATION OF KODACHROME STILLS TO BIOLOGICAL PHOTOGRAPHY*†

R. P. LOVELAND

Rochester, N. Y.

At last year's convention, Mr. Harris Tuttle announced to this Society the 16 mm. Kodachrome process as applied to medical and biological photography, discussing many details of the process.[1] The author wishes to call attention to the Kodachrome stills recently made available for miniature cameras, such as the Bantam, Retina, Leica, Contax, etc., since one of their greatest fields of usefulness should be in biological photography.

As those of you know who heard Mr. Tuttle or have used the process, Kodachrome is a subtractive, reversal process having pure dye images, whereby more brilliance is obtainable than by other methods. Moreover, it is a monopack process, that is, a single exposure per picture is all that is necessary, the final color-separation positive being superposed on top of acetate film. No special color camera or attachment is necessary. In fact, the chief advantage of the Kodachrome process is that the photographer has been relieved of all of the necessary intricacies of an efficient color process, since these have been collected into the processing stage, and it is merely necessary to send the film to experts equipped for processing it at the Kodak Plant. It can be handled and exposed in

* From the Kodak Research Laboratories, Rochester, N. Y.

† Read at the 1936 Convention of the Biological Photographic Association.

the same manner as any fast panchromatic film for black-and-white photography.

There are, of course, certain special precautions that must be observed. First, and probably foremost, is the quality of the white illumination. In the case of all single exposure, that is, monopack color films or plates, including the screen plate, the color balance is determined at once and during exposure by the quality of the illumination, that is, by the whiteness of the light. This factor is quite critical in the taking of color photographs if the subject has a full range of colors, especially blue. It is not so critical if only whites, yellows, and reds are present. Therefore, flesh colors or blood may appear quite satisfactory in the comparatively yellow light from ordinary tungsten bulbs, which is fortunate for medical and surgical pictures since the illumination for them must often be projected from medical spotlights. Even then it is best to put Photofloods in the spotlights, if possible. The color of the light used for *viewing* the finished pictures is not so critical. Ordinary tungsten bulbs of fairly high wattage may be used quite satisfactorily. Since the present Kodachrome film for miniature cameras has been adjusted for the quality of daylight illumination, a special compensating filter must be used for any other quality of light. Kodachrome film for use with tungsten light equivalent to Type A for 16 mm. Kodachrome will soon be available. As before, the quality of light obtainable from Photoflood lamps has been selected as the standard, as they are the most efficient for photography.

Much surgical and gross photography can be done by using ordinary high wattage tungsten bulbs, but the results are a gamble.

In photomicrography, the present daylight Kodachrome can probably be used with a white flame arc without a filter. Photomicrographs, both low and high power, can be taken with a Photoflood lamp as the source of illumination together with a special Kodachrome filter. This is the safest method and, with some preliminary care including the diaphragming off of excess light area to remove possible flare, is most satisfactory. Further details will be given in connection with the photomicrographic slides.

Many will want to take colored photomicrographs on their regular equipment, which includes a ribbon filament or other concentrated light source centered into their system. The color of a ribbon filament lamp is not only too yellow, but there is considerable variation between the

individual lamps. A Corning Daylite Glass filter might be interposed in the illumination beam and the rheostat of the tungsten illuminant adjusted until the white light on the ground glass appears to match the white light on another piece of ground glass illuminated from a Photoflood lamp. This will probably be most easily done if an ordinary hand mirror is used to view the ground glasses alternately.

After being assured that the illumination is of proper quality, the second general precaution is to exercise more care to obtain the correct exposure than is usually necessary in black-and-white photography. This is true of all color reversal processes. It is possible to advise the outdoor pictorial photographer who wishes to take Kodachrome stills to expose at *f*/11 for 1/25 of a second for average scenes in sunlight. No such standard conditions apply throughout the field of biological photography although individual workers frequently repeat the same conditions. The most helpful advice would be to express the Kodachrome exposure in terms of some panchromatic film with which the photographer has had experience or on which he may make an exposure test. Even then, with a miniature camera, it is often simplest and wisest to give a series of exposures with varied shutter times around the estimated exposure. A separate comparison must be made for each quality of light in comparing Kodachrome speed with a white light speed of any panchromatic film.

DAYLIGHT KODACHROME (K 828 OR K 135)

When used with daylight, this film has about the same speed as regular Eastman Panchromatic film.

With Photoflood illumination, the Wratten No. 80 filter or the Special Kodachrome filter for Photoflood must be used. Kodachrome film then has one-fourth the speed of regular Eastman Panchromatic film or twice the speed of Eastman Panchromatic Process film.

KODACHROME TYPE A FILM FOR MINIATURE CAMERAS AND ARTIFICIAL LIGHT

This film, which will be on the market soon, will have the same speed with Photoflood illumination as Eastman Super-Sensitive Panchromatic film.

It might be noted here that it was found convenient to interpose a neutral density of 1.0 in the illumination beam from a Photoflood lamp

when making photomicrographs by transmitted light at magnifications of from three to five times in order to lengthen the exposure to 1/20 of a second.

Because the optimum exposure in color photography is very critical, the use of photoelectric exposure meters is especially useful in gross and medical photography. This was discussed by Mr. Tuttle last year; however, please note the new Kodachrome speed equivalents just specified.

The exposure test method that was used for photomicrography is described here. A series of exposures with some suitable object were made and developed at once. An equivalent speed panchromatic film can be used for this purpose; preferably, the developer and development time should insure penetration throughout the film. A series of Kodachrome exposures were then made of the same subject under identical conditions and then sent for the usual processing. When the color films had been returned, the two strips were mounted together. It was then possible to make other exposure tests, with the same development as before and by comparison, first with our own developed test strip of the mounted pair and then with the corresponding colored frames of the completely processed strip, to judge the final result on processing for color.

Stills may be taken either for demonstration, publication or for purposes of record. Case records are familiar parts of medical photography. When stills are used to record various stages of a process or operation, the later study of details is much facilitated.

As Mr. Tuttle explained, the limitations imposed by surgical and clinical photography require the use of projection of most of the illumination, chiefly from medical spotlights and the use of very long focal length lenses. Excellent pictures were taken with a Retina camera fitted by Mr. Tuttle with an especially long focal length lens of $5\frac{1}{2}$ inches.

REFERENCE

(1) TUTTLE, H. B., AND HENN, H. J.: "Kodachrome and Its Application to The Medical and Biological Sciences," J. Biol. Phot. Assoc. **4:** March, 1936, p 136.

THE FOCUSING MICROSCOPIC AND PARALLAX VIEW FINDER*

MILTON COHEN

New York, N. Y.

The average ciné camera of today is deficient in many respects as far as being capable of producing highly technical film. Apparently the manufacturers have not stressed the use of such cameras for close-up photography, and thus have made little provision for doing such work. If close-up work must be done, necessary changes in the camera should be made.

First, and most important of all, is the correction in the view finder, so that what is seen through it will be the actual image that is photographed. Otherwise, a very serious error can be made if the subject is about 2 feet away. These view finders are often placed about 1 to 2 inches from the lens and hence will include a different part of the object than that taken in by the lens. For distances beyond 6 feet this error is negligible. However, for less than this distance some correction must be made so that the view finder takes in exactly the same field as the lens. This is known as parallax. The author has seen many cases where objects of importance were perfectly centered in the frame of the view finder, yet after the film was developed the discovery was made that these objects were missing.

Another important consideration is to insure accurate focusing while the object is constantly in motion. Since this was lacking in all cameras, the author found it necessary to devise some means by which this deficiency could be overcome.

There are several methods used in making the necessary adjustments, but only a description of the particular one employed by the author will be given. Probably the most versatile movie camera for all types of work is the Ciné Kodak Special. This camera has a focusing prism which can be placed directly in front of the film when the camera is not in motion, thereby obtaining a perfect focus. However, the prism cannot stay in this position when the camera is running, so we must use the finder directly above the lens for the necessary view and try not to change the distance between the subject and the camera.

* Received for publication October 8, 1936.

The author's method of overcoming this difficulty is as follows: An additional lens was mounted on the same horizontal plane as the one on the camera so that no vertical parallax would be encountered. The horizontal parallax was adjusted by a knurled knob (A) (Fig. 1a) which moved the lens on a pivot toward the lens on the camera so as to take in the same field of view. A Bell & Howell focusing microscope was ad-

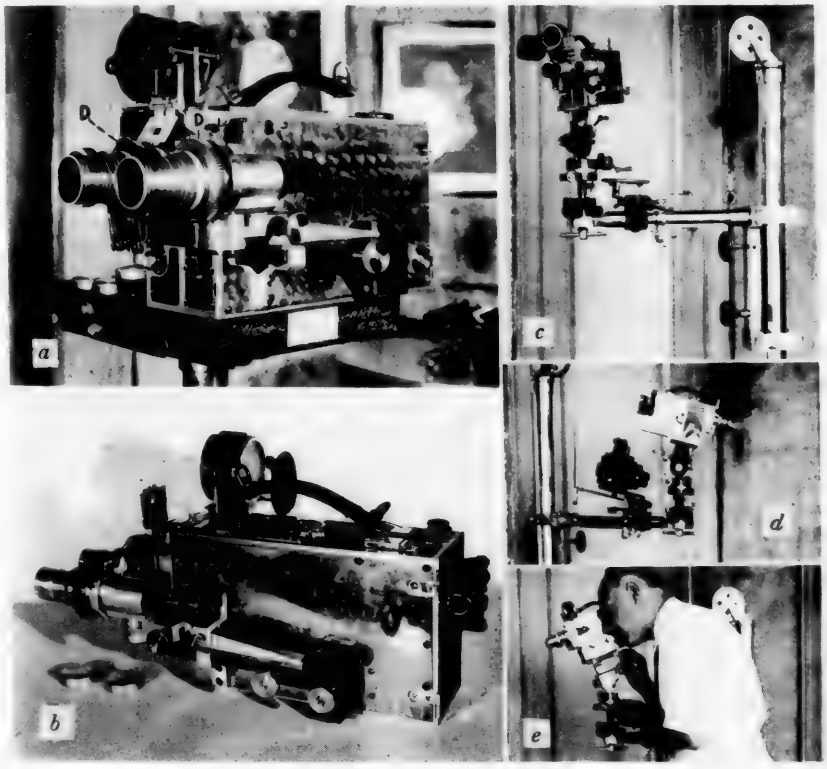


FIG. 1

justed to the rear of this lens so that the image would be visible on its ground glass (B). Since this image was inverted, a special reversing prism (C) was attached to overcome this difficulty.

Two gears (D and D) were attached over the focusing rings of both lenses. These were connected by means of a specially designed idler gear which could not disengage while the parallax adjustment was being

made. These gears made it possible to focus directly on the object through one lens and to be certain that the other lens was in focus at the same time. Of course, the lenses must be matched and the same field and focus obtained before the gears are engaged. Other knobs on the attachment were used to disengage the gears quickly and to insure other microscopic accuracies.

The camera, as seen in figure 1a, is also equipped with an exposure meter. This has been found extremely useful and has given consistently good results.

A special tripod designed from an X-ray tube stand made it possible for the operator to be seated while operating the camera. This tripod can be connected to a heavy table. A vernier gear was attached to the camera table to insure smooth panoraming and tilting. An adjustment was also made to facilitate the moving of the camera quickly from one extreme position to another. Both the camera and horizontal arm are counterbalanced and can be raised and lowered very rapidly with the least amount of effort. They can also be swung from side to side, as well as extended forward and backward without moving the tripod stand.

While the author derived a great amount of pleasure from designing and building this equipment, he feels that these necessary parts should be placed on some commercial cameras to fully satisfy the demands of close-up photography made upon the individual who is not mechanically minded.

A PORTABLE TIME LAPSE APPARATUS*

E. S. RINALDY

Chester, New Jersey

Several devices for time lapse work have been constructed and each seems to do the work expected. In each case, however, the subject is brought to the apparatus to be photographed except when the subject is of such nature as to preclude its being moved, in which case the apparatus is, of course, brought to the subject.

Moving the apparatus is not always easy as there are usually adjustments of camera and of controlling device, and also between these units. These adjustments are often tedious.

* Received for publication May 21, 1936.

The writer has considered portability a desirable feature in apparatus of this nature and has constructed equipment on this principle.

A case presented itself wherein it was desired periodically to film the amount, periods and duration of smoke from a chimney at some distance from the possible location of the camera, which happened to be on the roof of an adjacent building. The stop motion spindle of a Uni-

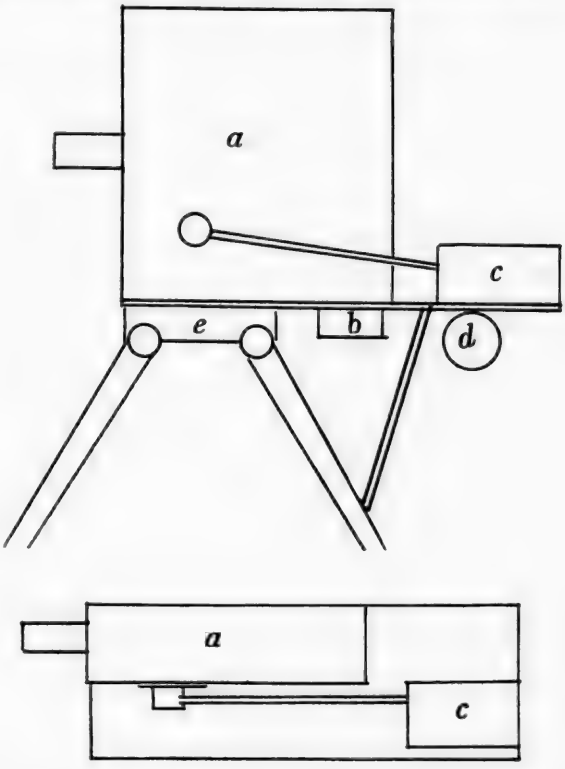


FIG. 1. *Top*, SIDE ELEVATION; *Bottom*, PLAN VIEW

A, camera; *B*, switch for lights; *C*, time lapse control; *D*, motor; *E*, tripod mount and support.

versal camera was flexibly connected to the time lapse unit which operated at predetermined intervals, the entire motion in this operation being controlled by a constantly running A. C. motor. Some difficulty was experienced in securing a motor that showed proper tachometer reading, but many high grade, small motors were available that showed only a negligible variation.

By geared reduction a shaft was rotated at 30 r.p.m., and from this constant a great many exposure periods were possible. For instance, one exposure every second, with intermediate divisions of time to one exposure every two hours, was possible. The length of exposure was selective, either long or short, as desired.

The change from the rapid to the less frequent periods was accomplished by simply changing a disc with its edge divided into the number of recesses necessary for the predetermined periods. As these discs were easily attached the action could be accelerated or retarded without interrupting the operation for more than two seconds. It was found that the unit was very well adapted to indoor work and others were built where artificial light was necessary, therefore a switch unit was added that operated on high amperage.

The light switch was of the mercury type and was synchronized with the operation of exposure when the circuit was closed one second before exposure and opened immediately after. This, of course, in the longer exposure periods was a saving of both current and life of the lamp, and is most necessary when certain micro-organisms are filmed. When the periods were frequent, however, it seemed advisable to use continuous light, so provision was made to keep the switch in contact when wanted.

The entire time lapse unit, including motor and light switch, occupies a space six by six by twelve inches and forms the base for the camera, the whole being mounted on a tripod for field work or on a bench or suitable stand for indoor work. When used for cinemicrography the bench should be of a size to accommodate the unit, microscope and lamp. As there is no vibration during exposure it is unnecessary to construct an especially heavy bench.

The camera mounted on the usual professional tripod was focused on a building for several weeks, exposing about 1000 feet, and there was no perceptible vibration noticed in the positive print when projected.

PHOTOGRAPHIC TECHNIC, NEW PROCESSES AND EQUIPMENT*

F. R. HARDING

Boston, Mass.

FINAL PREPARATION OF PRINTS: SPOTTING

The final step before delivering a photographic print should always be a thorough examination to determine whether or not spotting is necessary. Specks of lint and dust are often present on the surface of the printing glass and result in white spots on the print. All of these must be removed and the process of doing so is called "spotting." The material employed is simple. A spotting brush numbered 0 or 1 and a card of prepared spotting colors are all that are necessary. The card of colors usually includes black, sepia, and white. Cakes of water color, or India ink in stick form, may also be employed. The brush must come to a fine point when moistened and should be discarded after it becomes stubby.

Spotting is done by slightly moistening the brush with saliva, at the same time pointing it. The brush is then charged with the proper color and the center of the spot to be removed is lightly touched with the brush. Tiny spots will require only one "dab" with the brush, but larger ones will require more. This is done with a series of light "dabs," similar to the action employed in stippling. Remember that the color of the surrounding print and the color contained in the brush must match or the spotted area will be just as noticeable as it was before the spotting was started. When the brush is first charged, try the color on a piece of paper. If it is too dark, remoisten the brush and draw it along the test paper until the desired shade of gray appears. Moisten the brush as little as possible. This is one reason for employing saliva, as there is a wringing action of the lips when the brush is withdrawn. Another reason is that if water is used it will often "ball up" on the print, that is, it will not stay on the area it is placed upon but will roll up and deposit itself elsewhere. When saliva is employed this will not happen. Many agents have been tried in an effort to find a substitute for saliva, but professional spotters claim that nothing that is as satisfactory as saliva has as yet appeared.

The most difficult thing to spot is a straight line. The best method of dealing with this problem is to lightly stipple in the whole line, using a color that is two or three shades lighter than the surrounding area. Then go over the line again. Repeat this until the line blends with the surrounding area. If some areas are too dark, this can often be remedied by cleaning the brush, moistening it and stippling the dark areas. This removes color.

Spotting requires practice and one should not be disappointed if the first efforts are not successful. A little practice will work wonders. There is a great difference in the appearance of two identical prints, one of which has been spotted and the other which has not been spotted. Pride of workmanship alone should make one spot prints. The writer recently went to an exhibition of photographs. One of the exhibitors had

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* From the Department of Photography, Children's Hospital.

a truly fine display. The photographs were well lighted and of excellent color, but they had not been spotted and needed it badly. This omission spoiled the appearance of an otherwise fine display. They were all enlargements, which usually need more attention than contact prints, since the dust also is enlarged. In recent years there seems to have developed an increasing amount of slack workmanship upon the part of photographers in general. They make technically good negatives and prints, and then deliver them poorly mounted and virtually unspotted.

DUFAYCOLOR FILM

The following directions for processing Dufaycolor film have been supplied by Mr. St. Clair of Boston, Mass. who has used the formulas and other information for some time with excellent results.

Load the camera with the emulsion side away from the lens.

Weston Universal Meter film speed 6, is used in daylight.

Ordinarily no filter is employed, but in excessively intense light or blue haze use the ultraviolet filter.

Artificial lighting requires a special filter.

DEVELOPING PROCESS CARRIED OUT AT 65°F.

1. Desensitize in Pinacryptol yellow in complete darkness for 2 minutes.
2. Rinse.
3. Develop in dim O.A. light. Normal time is 2.5 minutes but varies as inspection indicates.
4. Wash 1 to 2 minutes.
5. Bleach 2 minutes.
6. Wash 1 to 2 minutes.
7. Expose to the light of 2–60 watt lamps 1 foot away for 3 minutes.
8. Redevelop 3 minutes.
9. Wash 1 to 2 minutes.
10. Fix.
11. Wash 2 minutes.
12. Dry. Pat (not rub) with viscose sponge and hang up to dry in dustless place.

DESENSITIZER

Agfa Pinacryptol yellow. Dissolve 1 gram in 1 liter of water. Add 1 liter of cold water. Allow to cool. Store in brown bottle in the dark.

First developer

A	Water, 125°	750 cc.
	Sodium sulphite	48.8 grams
	Hydroquinone	24.4 grams
	Boric acid crystals	5.6 grams
	Potassium bromide	2.6 grams
B	Water—cold	250 cc.
	Sodium hydroxide	24.4 grams

Use 3 parts A to 1 part B

Bleach

A	Water	500	cc.
	Potassium bichromate	2	grams
B	Water	500	cc.
	Sulphuric acid (C.P.)	10	cc.

Use 1 part A to 1 part B

Redeveloper

Boris paper developer for hard prints

Fix

Acid hypo—as for prints and films

BORIS PAPER DEVELOPER

A	Water	40	oz.
	Metol	.25 54.7	oz. gr.
	Sulphite	1.5	oz.
B	Water	40	oz.
	Hydroquinone	.25 13.6	oz. gr.
	Sulphite	1.5	oz.
C	Water	40	oz.
	Sod. carbonate	3	oz.

Boris paper developer—Mixing

	Hard	
A	1	oz.
B	10	oz.
C	10	oz.
Water	21	oz.
Pot. bromide saturated solution	21	drops

REDUCER

A 70 grains Potassium cyanide
Water to 8 oz.

B 70 grains Red prussiate of potassium
Water to 8 oz.

Use 1 part A
1 part B
4 to 8 parts water

Fix Plain hypo

INTENSIFIER (IN—5)

℔1 6 grams of Silver nitrate crystals
Water to 100 cc.
℔2 6 grams of Sodium sulphite
Water to 100 cc.
℔3 10.5 grams of hypo
Water to 100 cc.
℔4 1.5 grams of Sodium sulphite
2.4 grams of Metol
Water to 300 cc.
Use: Add ℔2 to ℔1 while stirring
Add ℔3 and let stand to clear
Add ℔4 while stirring
Time: 10 minutes should be limit
Fix: 2 minutes in 30% hypo
(300 grams hypo
1000 cc. of water)

PRINT CRITICISM

LOUIS SCHMIDT

New York, N. Y.

The two photographs on page 87, of the same patient, illustrate the value of shadows in a picture. The object of the pictures was to show the deep depression in the region of the sternum. In the first picture the patient was turned to the right, bringing the left shoulder near the camera, so as to outline the left breast against the shadow of the right breast. The light was from above and to the left.

The picture failed because the shadow of the right breast was not dark enough to indicate the deepness of the cavity between the breasts, although the shadow in the left axillary region is ample. If the light had been moved back so as to produce more of a side lighting, the shadow of the right breast falling into the depression on the line of the sternum would have been darker and the result better.

However, the front view is far better. Lighted from above and to the left with the light source well back from the subject, the hollow between the breasts is very well demonstrated. With no dependence placed on line, all the surface modelling is clearly shown and the abnormality is unmistakable.

This result depends on placing the light far enough to the rear of the subject to produce almost a side lighting. All the surface modelling of the chest is clearly shown. With such a problem too much light or misplaced light leads to failure.

THE PRESIDENT'S ADDRESS

The Good of the Association and Its Members

Five years have passed since a group of individuals met at the Yale University School of Medicine, at the invitation of Ralph P. Creer, who had previously visited many of those invited and corresponded with others. At the time there was no association in existence in this country whose members served the biological sciences. Technical groups had been formed, as subdivisions of large photographic societies, but had proven short-lived. Those who composed our original membership were mostly experienced photographic craftsmen who had worked out their own methods independently. They came from the ranks of scientific illustrators, commercial photographers, scientific investigators and laboratory technicians. They were animated by high enthusiasm and a willingness to share their knowledge with their fellows. There were twenty-seven men and women present. Of this number seventeen are still on the roster of the Association's hundreds of members.

It seems fitting that we should now look back to our beginning, review our expectations and accomplishments, take note of the difficulties we have encountered and consider the problems of the future and the ways and means of solving them. At the start we felt sure an association of biological photographers, using biological in its broad, inclusive sense, would fill a long-felt want and would meet with an immediate and enthusiastic response. The original plan was very simple; we proposed to have an annual convention in September and a spring meeting. It was suggested that perhaps in the second year we might manage to supply mimeographed typed reports of the meetings to members for the benefit of those who were unable to attend. A widespread membership was not expected. The original group was from New England and the Middle Atlantic States. Rochester, N. Y., and Baltimore, Md., were the outposts.

On such a basis we could have functioned on the dues of $3.00 a year. Articles written by our members could have been published in one of a number of photographic journals. Our growth would have been restricted by geographic limits, and would have been slow. It is a question whether with such an organization we could have maintained the interest of the members and kept them in the Association permanently.

At the Directors' Meeting in the summer of 1932, the advisability of publishing a journal was discussed. After much argument pro and con it was the view of the majority that the Association ought to have its own journal, as this would at once widen the scope of the Association and bring in members from coast to coast. It was thought that the entire cost of a small quarterly journal could be covered by receipts from advertisements and subscriptions, and from part of the first year's dues of those members who joined us as a result of journal publicity.

As it happened, we did get a widespread membership within a fairly short time, but numerically it was small. We, as well as prospective members, were already feeling the pinch of the depression. It soon became evident that advertising space in the JOURNAL was hard to sell under these conditions. We found that a considerable number of members, due to layoffs or cuts in salary, failed to pay their dues even though they were receiving a very useful and attractive quarterly journal without any advance in dues. During the years 1934–35 repeated efforts were made to bring these delinquent members back into the fold by cancelling back dues and starting them anew. These efforts met with some success.

Hard times made adjustments necessary. One of the most disastrous results had been the heavy deficit in the first nine months of the JOURNAL account. It was necessary to make a new contract in order that the JOURNAL might continue and the Association be saved from discredit and bankruptcy. The terms of the new contract required us to pay $2.00 per year for each member's subscription, leaving us only $1.00 balance from the annual dues. This, with the $1.00 registration fee at conventions, which only a fraction of the members were present to pay, constituted our total income. Under these difficult conditions we struggled through 1932–33–34.

At the 1934 Convention in New York we staged our first competitive print exhibit and the first technical display for which space rental was charged. As a result the cash balance of that Convention was greater than the equivalent dues of 125 new members. At the same time the subscription price of the JOURNAL was raised from $2.00 to $3.00 to non-members, thus creating an advantage in being a member rather than a subscriber and inducing former subscribers to become members. The same plan of a convention, with technical exhibits, was followed in Chicago a year later.

There may be some who think that they can get all the benefits of membership simply by reading our JOURNAL in a library. We must convince such persons that the Association gives many services to its members in addition to JOURNAL subscription.

For instance, a scientist member who wishes to hire a competent craftsman to organize a photographic department or fill a vacancy can, through our Secretary, make contact with a group of high class applicants from which to choose. This serves the one who employes and the one who is employed.

Questions about equipment to meet certain requirements and budgets will be answered through the Secretary, and expert advice will be given on problems of technic.

Our conventions are a source of inspiration and valuable professional contacts. The print exhibits collect the work of members and give clear descriptions of the methods employed. The technical display, by no means least in value, brings together much that is new in materials and apparatus and shows the results that may be obtained by their use.

The prints shown on these occasions are exhibited in many cities as the Travelling Salon of the Association It may be sponsored by a member or a group of members and exhibited in their own locality, with their own prints added, at a cost of one way transportation.

Some of our members are isolated at a distance from the location in which the convention is held and it is sometimes difficult for them to attend. For these persons the JOURNAL is a great boon. For their benefit we are also building up a series of loan albums filled with photographs and containing accurate descriptions of the methods used in producing them. They may be borrowed for a reasonable time by paying the cost of transportation. We have loan albums from the University of Maryland and The Rockefeller Institute for Medical Research containing photographs, with pictures or plans of the apparatus used and descriptions of technic. The Rockefeller Institute for Medical Research at Princeton has lately contributed a new album on plant photography. We hope to amplify our collection.

Any individual firm or organization may, if they wish to help us and to add to our usefulness, become a Sustaining Member, dues for which are $10.00 per year. This contributes to our financial support the equivalent of 8 annual members.

We know from our correspondence that we have been of great service to some of our members, particularly those in isolated localities. The amount of that service has depended much on the personality and cooperative spirit of the individual member. As an example I present the experience of one member who has not hesitated to ask for help and service.

He became a member in February, 1934. Since then he has organized a photographic department in his hospital. He has prepared exhibits for two meetings of the A.M.A. and one for our Chicago exhibit. He was helped in his planning and procedures by our Journal and by correspondence with the Secretary and with members to whom she referred him. He was advised about equipment to suit his needs and budget. From one member he got specialized help in photomicrography in color.

He arranged for the Exhibition of Salon No. 1 at his hospital, thus bringing it before a group that we could not otherwise have reached. He wrote, "there is considerable interest in it here. I feel that it will be a fine boost for our young department." He has always reported his results to us, when working with technique suggested by us, and added valuable comments of his own. From his letters we may glean many valuable hints for others who are in the position that was his in 1934. He keeps us advised of his results with new materials and he has secured new members. Next year he expects to study general pho-

tography and spend some time as an observer in a number of laboratories whose personnel he has met through the Association. He writes, "I hope I can repay in part my debt to the Association for the generous help it has given me. Let me know if I can lend a hand at any time. I am sincerely grateful for your help. It has been a real inspiration to me."

Undoubtedly we have helped him; saved him time and material by relieving him of many errors and much experimental work. This we were able to do without much trouble by cooperating with him and tapping our store of accumulated experience. He has offered in exchange his own findings which we can use for the benefit of ourselves and others. When we give a member an idea and he gives us one, we all gain. This is but one of many similar cases. The more such cases we get the better we can serve the needs of all our members.

As to our present membership, a few statistics are given for your information. We have members in 28 states, but in 8 we have but one member in each; 61% are in the New England and Middle Atlantic States; 30% are in New York State; 9% in Pennsylvania; 8% in Massachusetts; 7% in Connecticut; 5% in Illinois, etc. We have 9 foreign members, 4 in Canada, one in Mexico, one each in France, Holland, Denmark and Czechoslovakia. Dr. Prát of Prague has sent pictures to all our exhibitions.

As regards professional distribution, we have 66% of our members in the medical and dental sciences; 34% in the other biological sciences. To analyze the distribution from the point of view of the status of the workers, we have:

Photographic craftsmen	28%
Scientists who direct or do their own photography	38%
Technician-photographers	22%
Free-lance photographers	11%
Connected with commercial houses	11%

Certain localities show a rapid increase in members easily traceable to the efforts of one energetic member, which should encourage all of us to pay attention to our need for greater membership. The proportionate cost per member decreases with the increase in total membership.

So far we have considered the past, its problems and accomplishments. We must now face the responsibilities of the future and study the ways and means of solving them.

If the state of the treasury permits, it seems only fair that a part of the deficit incurred in launching the Journal should now be paid.

The question of the advisability of incorporating the Association should be considered, for by this means we can prevent the financial liability of each member for the debts and acts of the organization.

We should undertake a vigorous publicity campaign, directed not only at photographers and technicians who practice photography, but to those who employ them. It should be brought to the attention of the photographers that their work would be improved by association with our members, and that their professional dignity will be enhanced by belonging to this organization. Perhaps the Association and the publishers could get together on this plan with a free use of reprints and some sample copies of the Journal as ammunition. It may be well to try such a plan in a given locality and study the results before embarking on a wide scale.

Frequently we have been urged to publish a textbook of biological photography. In my opinion the time for this has not come. As a move in this direction it may be feasible to publish monographs on selected subjects for the use of our members, made up of mimeographed sheets perforated for loose-leaf binders. The subjects most in demand should be published first and only if the demand justifies production and is on a paying basis. The subjects might be: Gross Specimens; Cultures in Tubes and Dishes; Instruments and Glass; Botanical Subjects; Cinematography, Gross and Micro. This project should have careful consideration and should only be undertaken if it can pay its way. Even though our membership increases, we should only embark on additional services that will support themselves. This is because our dues are low, and it is not practical at the present time to raise them. Perhaps we may be justified in asking for an initiation fee of two dollars. As an experiment we have placed the registration fee at $3.00, thinking the convention ought to be worth that sum if it is worth anything, and that the commercial firms will be more willing to give their support to our conventions if we show a willingness to do likewise.

A few general suggestions: it may be well, when the third Travelling Salon is released, to group together the best material in the first and second Salons. It will then be offered for exhibition as an alternative Salon with the third under the title Selected Prints from Salons of the Biological Photographic Association. It is suggested that some member

have charge of the Salons, not only to see that they are sent to those who ask for them, but also to create a demand by writing to a number of members in certain localities, so that the exhibits may be held at a minimum transportation cost. The same plan should be followed with the albums. The microscopic competition, too, should be turned over to one member for attention. It has not worked out very well so far. A continued effort should be made by one person to keep the slides moving from member to member. We have asked the members through the Journal to ask for the Salons, albums and slides, but they need persistent reminders. We photographers are notorious procrastinators.

It may be important to face the fact that your officers must write many letters, either in longhand or on the typewriter, so that much of their time is consumed in doing work for which they are not trained. If possible, stenographic service should be paid for by the Association. Otherwise, some of the best officer material will be unavailable to us, because busy men and women will have to decline office.

If there are any suggestions to be made toward the good of this Association and its members, may we have the benefit of your ideas?

LOUIS SCHMIDT,
Illustration Division
The Rockefeller Institute for Medical Research, New York, N. Y.

Association News

The Sixth Annual Convention of the Biological Photographic Association was held in the Hotel Lenox, Boston, Mass., September 24–26, 1936. The program committee, under the guidance of Mr. Ferdinand R. Harding, presented in the program a number of important and instructive papers. Mr. Louis Schmidt, in his presidential address, spoke of the hopes and aspirations of the Association and the efforts that are to be put forth to make the Association more valuable to its members. Dr. Bruce Mayne, the official delegate of the U. S. Public Health Service, spoke regarding the "Parasitology of Malaria in Man and the Mosquito." Prof. C. T. Brues, Harvard University, outlined the importance of motion pictures as an aid in teaching entomology.

Since motion pictures in color have become such an important means of depicting surgical procedures, the paper by Mr. Harris B. Tuttle concerning the use of 16 mm. Kodachrome A film in photographing surgical operations was of particular interest. The vividness with which color depicts the surgical field now makes Kodachrome one of the important adjuncts to every hospital photographic laboratory. The value of still photographs in color has ever been unquestionable in the portrayal of skin lesions, gross specimens and other medical subjects. Therefore, the paper by Mr. Roger Loveland which announced the new 35 mm. Kodachrome film for still photography was gratefully received.

Prof. Arthur C. Hardy of the Massachusetts Institute of Technology gave an interesting paper concerning the "Depth of Field in Photomicrography." From another department of that Institution, Dr. Harold E. Edgerton gave a remarkable exhibition of the results of his work in high speed photography.

Thursday evening, September 24, Mr. James R. Brewster of the Harvard Film Service projected the following 16 mm. motion pictures:

Relation of Absorbable Catgut Sutures to Wound Healing. Courtesy Davis & Geck, Inc. This film contained reproductions of blood photomicrographs by Philip Gravelle.

Larynx and Total Thyroidectomy. Courtesy Mayo Clinic. Made by Leonard Julin.

Commercial Production of Yeast. Courtesy Fleischmann Laboratories. Made by William Schanzenbach.

Collecting Fishes for New York Aquarium. Made by S. C. Denton.

Deep Sea Life. Courtesy Harvard Film Service. Made by James R. Brewster.

The banquet was well attended and thoroughly enjoyed by everyone.

Climaxing the program on Saturday was the showing of three-dimensional motion pictures by the Land-Wheelwright Laboratory of Boston. These motion pictures permitted a tremendous stereoscopic effect to be obtained by the use of polaroid screens. In other words, these motion pictures were made entirely with polarized light.

Although not scheduled on the program the individual contacts made each year

with old and new members are most interesting and illuminating. By this means many valuable ideas may be obtained. Talking shop in a new way is really a novelty.

The spirit of cordiality and enthusiasm exhibited by all those attending was particularly pleasing since it indicated continued interest in the Association and its endeavors. There can be no question but what these meetings are of the utmost importance to each member of the Association, and it behooves everyone engaged in biological photography to make every effort to attend the annual conventions.

The following officers were elected for this fiscal year:

President: Mr. Louis Schmidt
Vice President: Mr. Leonard Julin
Secretary: Miss Anne Shiras
Treasurer: Miss Stella Zimmer
Directors: Mr. Ferdinand Harding
Mr. Philip Gravelle
Mr. Henry Morris

The new directors are all veterans not only in membership in the Association, but also in photography.

An excellent exhibit of photographic equipment especially suited to scientific and biological photography was displayed by the Bausch & Lomb Optical Company, Bell & Howell Company, Eastman Kodak Company, E. Leitz Company and Hammer Dry Plate Company. The thanks of the Association are extended to these manufacturers for their gracious participation in the Convention.

The management of the Hotel Lenox was most helpful in the staging of the exhibition, and all arrangements for our comfort were provided. The hanging of the print exhibit was based upon the idea that the medical and the nonmedical subject matters should each be grouped with kindred subjects. This arrangement proved quite satisfactory. A simplified method of awards worked rather well as compared with former years and was a welcome change for the judges who previously shouldered a heavy task. Many of the exhibitors of prints resorted to decorative effects with respect to borders, lettering, etc. Such ornamentation should be restrained in future exhibits since it tends to detract from the qualities of the print itself. On the whole the exhibition of prints indicates that the trend in the quality of the work exhibited is definitely upward.

Members receiving awards for prints shown in the *Print Exhibition*, are as follows:

Name	*Subject*
J. A. Carlile, Rockefeller Institute for Medical Research, Princeton, New Jersey	A. aegypti larvae in tube, ×4. H. H. Contoatus, ×605
Ralph Creer, Veterans Facility, Hines, Illinois	Gross specimen photographs; heart and bone.
Philip O. Gravelle, F.R.P.S., F.R.M.S., 114 Prospect Street, South Orange, New Jersey.	Cardioid, ultramicroscopic; human blood, dark field.
Ferdinand Harding, Children's Hospital, Boston, Mass.	Group of clinical photographs; muscles and tendons.

Name	*Subject*
Jean Kieffer, Norwich State Tuberculosis Sanitorium, Norwich, Conn.	Group of 5 x 7 (Finlay process) color photomicrographs.
Wilbour C. Lown, Massachusetts General Hospital, Boston, Mass.	Group of medical photographs.
Adolph Marfaing, 450 West 162nd Street, Columbia University, Institute of Ophthalmology, New York City.	Group of eye photographs; anterior and corneal.
Leo Massopust, Marquette University, Milwaukee, Wisconsin.	Crystallography by polarized light, and infra-red photographs of gross specimens.
Stanley J. McComb, 1026 Sixth Avenue, S. E., Rochester, Minn.	Group of Eastman wash-off relief color prints.
Henry Morris, University of Minnesota, Minneapolis, Minn.	Group of Translite transparencies; miscellaneous medical subjects.
Louis Schmidt, Rockefeller Institute for Medical Research, New York City.	Group of photomicrographs.
Richard St. Clair, Massachusetts College of Pharmacy, Boston, Mass.	Group of photomicrographs of wood sections.
Percy G. Sutton, Schatzalp Sanatorium, Davos, Switzerland.	Group of radiographs.
Stella Zimmer, Syracuse University, Syracuse, New York.	Group of photomicrographs of blood.

* * * *

It should be made clear to all nonmembers that we welcome into the Association workers whose methods and tools are similar to ours but are not confined to the biological field. To these people we offer membership in our Association and also the pages of our Journal for the presentation and discussion of their problems and needs.

* * * *

A new album has been added to those already assembled. This album was prepared by Mr. Julian Carlile, who has grouped a large number of photographic prints of plant life. Each group of photographs is supplemented with pictures of apparatus and lighting, together with the complete technic and processing formulae employed. This album may be loaned at a small cost to cover transportation by writing to Miss Florence Melvin, 713 Franklin Avenue, Columbus, Ohio.

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We wish to extend our sympathy to one of our directors, Mr. Leo C. Massopust, who after making the long journey from Milwaukee, Wisconsin to Boston for the Convention, was obliged to return home immediately to attend the funeral of his father.

Mr. Henry W. Morris also was obliged to return home before the end of the meeting owing to the desperate illness of a member of his family. To him we also extend our sympathy.

The First International Exhibition of Applied and Scientific Photography will be held in Rochester, New York, from March 15 to April 3, 1937, under the auspices of the Scientific and Technical Sections of the *Photographic Society of America*. The exhibition will be held in the Rundel Memorial Building, a new, conveniently placed, desirable building with exceptional facilities for showing both pictures and apparatus. The last day for receiving prints will be February 1, 1937.

The exhibition committee consists of Gustav Fassin, *Chairman*, Dr. T. R. Wilkins of the Institute of Optics, University of Rochester, Rowland S. Potter, Vice-President, Defender Photo Supply Company, Dr. Walter Clark, Glenn Matthews, Dr. E. P. Wightman, John McFarlane, Arthur W. Fuchs of the Eastman Kodak Company and C. B. Neblette, *Secretary* of the Scientific Section.

It is the aim of the organizers to establish an annual exhibition which will be representative of the many applications of photography in science and industry. The ten sections organized are as follows:

Astronomy, meteorology, light-sensitive substances. Dr. Walter Clark.
Photomicrography, microphotography, metallography. Mr. Gustav Fassin.
X-ray spectrography. Dr. Walter Clark, Dr. B. O'Brien.
Cosmic ray photography and theoretical physics. Dr. T. R. Wilkins.
Press photography. Mr. C. B. Neblette.
High speed photography. Mr. Glenn Matthews.
Technic of color photography. Mr. Rowland S. Potter.
Photography by invisible radiation. Mr. John W. McFarlane.
Aerial photography. Mr. Glenn Matthews.
Medical photography and radiography. Mr. Arthur W. Fuchs.

Photographs showing the application of photography in any of the above or other fields of science or technology, as well as instruments employed in applied photography, will be welcomed from any part of the world.

For particulars, address the *Secretary*, C. B. Neblette, F.R.P.S., Department of Photographic Technology, Rochester Athenaeum and Mechanics Institute, Rochester, New York, U. S. A.

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In spite of snowy weather and election activities, a large group of members turned out for the first fall meeting of the *Pittsburgh Chapter* on November 4. The meeting was held at the Falk Clinic and the following program was thoroughly enjoyed:

16 mm. Kodachrome film as used by Dr. George J. Kastlin and Dr. Lester Hollander in illustrating "Diseases of the Lymph Glands." Presented by Dr. Kastlin.

"The Use of Direct Duplicating Film" by Dr. Morris A. Hershenson. The means of making direct positives without the intermediate step of a separate negative. Illustrated by a demonstration of the originals and the direct duplicate pictures.

An interesting *round table* discussion was held as a part of the meeting wherein an exchange was made of questions, ideas, photographic details and timesavers.

The *Third Travelling Salon* of the national association was on display. This exhibit depicted groups of photographs concerning: the photography of gross specimens; crystallography with infra-red light; plant photography; photomicrography; photography of the eye; natural history subjects; experiments in photomicrography with various types of lighting; photography of body cavities; reproductions of radiographs.

A group of interesting photographs of the uterine cervix has just been included in the travelling print exhibit. These photographs were made by Dr. J. M. Bruner, Dr. L. E. Rosebrook, and G. W. Cushman of Des Moines, Iowa. The technic employed in making these photographs was described in the September number of this JOURNAL.

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The Brooklyn Institute of Arts and Sciences will offer a course in color photography for the 1936–37 season. Norris Cummins, former associate of Edward J. Steichen, photographer for Condé Nast publications, will be the instructor.

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At the meeting of the American Roentgen Ray Society in Cleveland last September, Messrs. Jean Kieffer and A. W. Fuchs constituted themselves unofficial judges of the photographic qualities of the scientific exhibits. It was gratifying to note that in those exhibits showing the highest quality, the work was invariably found to have been done by members of the Association. Some outstanding exhibits, however, were prepared by nonmembers and it behooves our *Secretary* to gather into our fold the photographers who prepared these exhibits.

* * * *

Mr. Louis Schmidt, President of the Association, recently visited Mr. William J. Taylor, one of our oldest members and for one term a director of the Association. Mr. Taylor came east with his chief, Dr. Chamberlain, from California, to fill a position combining radiography and photography. He is now doing photography exclusively at the Samaritan Hospital, Temple University, Philadelphia, Pa.

Mr. Schmidt reports that the laboratory is roomy and excellently equipped, the output is large and the quality of the work is high. The washing and developing temperatures are controlled by a G. E. refrigeration unit and airconditioned ventilation is available to all rooms and dryers. The safelight lamps are equipped with white and colored safelights which are changed by raising the hinged front of the lamphouse. This may be easily done with one hand while holding the negative with the other. A similar light unit of 14″ x 17″ size gives even illumination to negatives for the production of lantern slides, which are made with a 5″ x 7″ camera inverted perpendicularly over this illuminator.

The studio is amply equipped with side and ceiling lights, and with two 1000 watt spotlights which are also used for copying. Mr. Taylor is planning soon to bring together all of our Philadelphia members with others who are interested in biological and technical photography in an effort to launch a Philadelphia Chapter of the Association.

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The first fall meeting of the New York City Chapter met in the new quarters of the Bausch & Lomb Optical Company, in the R. K. O. Building, Rockefeller Center, October 23, with Chairman Carlile presiding. Mr. Joseph Hackel, a member of the Association, spoke on the development and usefulness of the motion picture in the teaching of surgery, in which he pointed out that motion pictures are not only one of the best means of instruction but are also indispensable. He brought out many

technical points and illustrated them with black-and-white films with sound. He also showed a fine color film of plastic surgery of the face, with supplementary sound films. Mr. Hackel advocated the visible printed titles in addition to the sound film. He later demonstrated his own motion picture camera unit which included platform, lights, camera and all accessories, contained in a cabinet which was mounted on casters. The tripod and lamp brackets are attached to the platform so that everything is in the control of the operator. The equipment may be carried in a small car and can be lifted by two men. Once it rests on its casters, it is completely portable.

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The Fourth Exhibition of Professional Photography sponsored by the Department of Photographic Technology of the Rochester Athenaeum and Mechanics Institute, Rochester, N. Y., will be held from March 1 to 15, 1937. The last day for receiving entries is February 15, 1937. As usual there are no entry fees and all prints are returned by express collect, no charge being made for packing or shipping.

This exhibition should receive special attention from professional and technical photographers as it is the only exhibition held exclusively for and restricted to this class. The sponsors are genuinely desirous of showing the best contemporary work in the fields of commercial, illustrative, portrait, biological, color and press photography. The prints to be shown will be selected by a competent jury of professional photographers. Begin now to lay aside some of your best negatives and prepare for the professional's own salon, the Fourth Exhibition of Professional Photography, Rochester, March 1 to 15, 1937. Entry blanks will be mailed on request.

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The American Medical Editors' and Authors' Association is most anxious to bring about a closer relationship between author and publisher. The director of the Association wishes to announce that articles on medical subjects may be submitted to him for editing and putting into shape for publication. This service will be rendered free of charge. If the manuscript submitted has any real value, with the author's consent it will be submitted to some medical journal in his neighborhood for publication.

It is sincerely to be hoped that medical men, particularly those who have hesitated to publish articles in the past, will take advantage of this offer. The author need not be a member of our Association. Address all manuscripts to Dr. Harold Hays, director of the American Medical Editors' and Authors' Association, 133 East 58th Street, New York City.

Frequently medical men find it difficult to obtain references in past medical literature which will help them in preparing a medical paper.

The largest medical library in the United States is in the Surgeon General's office. The second largest, we believe, is in the New York Academy of Medicine. The services of the Academy library are available at all times. The American Medical Editors' and Authors' Association, through its director, Dr. Harold Hays, can arrange to supply references or abstracts on any medical subject. This service is available to any scientist. The cost will depend upon the amount of information desired. The original bill rendered by the Academy will be sent to the person making the inquiry. The Association makes no charge. This is but one of the services our Association wishes to render to doctors.

Mr. Robert Sage of the Iowa Methodist Hospital, Des Moines, Iowa, is spending the winter at the University of Maryland, where he is finding plenty of interesting photographic work to do in Carl D. Clarke's laboratory.

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The following new members are welcome additions to the Association. It is felt that their memberships will be of distinct mutual advantage.

J. Wilbur Armstrong, M.D., Berea, Kentucky.
C. H. Ash, Spencer Lens Co., Boston, Mass.
John J. Beiter, 490 Westfield St., Rochester, N. Y.
Professor Edward A. Benbrook, 2318 Baker Street, Ames, Iowa.
R. J. Bennett, M.D., 10960-84th Avenue, Edmonton, Alberta, Canada.
Olaf Bloch, 11 Russell Chambers, Bury Street, London, W.C. 1, England.
Julian M. Bruner, M.D., 1005 Bankers Trust Bldg., Des Moines, Iowa.
Emil Forney, Ayer Laboratory, Pennsylvania Hospital, Philadelphia, Pa.
Max Freydeck, Medical College of Virginia, Hospital Division, Richmond, Virginia.
Nicholas G. Grand, Box 1257, University, Alabama.
Arthur A. Hebert, Jr., 55 Allyn Street, Hartford, Conn.
Roy W. Heiser, Washington Hospital, Washington, Pa.
Miss Mildred Holt, 739 Boylston Street, Boston, Mass.
Nathan S. Horton, 781 William Street, Montreal, Canada.
Francis W. Joyce, M.D., 4001 California Avenue, Pittsburgh, Pa.
Professor Paul Knight, University of Maryland, College Park, Md.
Frank A. Lowe, M.D., 503 Flood Building, San Francisco, Calif.
Frederic Messer, J. C. Oliver Memorial Research Lab., Pittsburgh, Pa.
Hugo G. Rodeck, University of Colorado Museum, Boulder, Colorado.
Louis A. Rosenblum, M.D., 1778 E. Ninth Street, Brooklyn, New York.
Miss A. Marie Schaper, Children's Hospital, Pittsburgh, Pa.
Jack Seltzer, 84 Exeter Street, Boston University, Boston, Mass.
Fred Sinemus, 3530 Louisa St., Pittsburgh, Pa.
G. W. Stoler, M.D., 236 N. Duke Street, Lancaster, Pa.
Hyman Strauss, M.D., 755 Ocean Avenue, Brooklyn, New York.
Francis R. Sullivan, 20 St. Stephens St., Police Department, Boston, Mass.
Percy G. Sutton, Villa Fortuna, Davos-Platz, Switzerland.
C. A. Swinyard, M.D., 121 Park Drive, Boston, Mass.
H. B. van Wesep, Rockefeller Foundation, 49 West 49th Street, New York City.
Adrian W. Voegelin, M.D., 1521 Lindley Avenue, Philadelphia, Pa.
Professor William H. Weston, Biological Laboratories, Harvard University, Cambridge, Mass.
Walter W. Woodhouse, M.D., 416 Brilliant Avenue, Aspinwall, Pa.

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City and county public school superintendents and principals of private high schools in 9,000 communities throughout the country supplied information to the United States Office of Education and the American Council on Education in a recently completed National Visual Instruction Survey.

First complete findings of the survey, which covered visual and audio aids offered 17,000,000 pupils and brought information from 95 per cent of all cities with a population of 5,000 or more, were recently announced by John W. Studebaker, United States Commissioner of Education. Cline M. Koon, U. S. Office of Education Specialist in Radio and Visual Education, directed the survey and was assisted by Allen W. Noble.

Dr. Studebaker said, "The National Survey of Visual Instruction just completed by the United States Office of Education, with few exceptions, reveals that our nation's 280,000 public and private schools are poorly equipped with motion picture projectors, film supplies, radios and other visual-audio aids necessary for the transmission of knowledge and ideas with the effectiveness which is now possible.

"Our schools accommodate more than 33,000,000 men, women, and children in the quest for education. These schools provide practically a virgin field for silent and sound motion picture projectors and equipment, radios, and the many other similar aids needed in the modern classroom.

"It is estimated," says Commissioner Studebaker, "that the 33,000,000 persons enrolled in America's public and private schools spend about 825,000,000 hours per week in school as compared with only 225,000,000 hours per week spent in the 15,000 theaters throughout the country by 90,000,000 persons, yet only 750 sound motion picture projectors have been reported as belonging to our nation's schools.

"This National Visual Instruction Survey should point the way to a larger production, distribution, and use of visual-audio equipment for educational purposes in the United States."

The nation-wide study made by the Office of Education and the American Council on Education reveals that more than half of the 81,000 schools reporting are electrically equipped. Lantern slides, motion picture and radio equipment owned by 42,000 schools include 27,000 lanterns and other types of slide projectors, 9,000 silent and 750 sound motion picture projectors, 11,000 radio receiving sets, and 850 central radio sound systems. There is also considerable renting and borrowing of this type of equipment.

More schools report using motion pictures for teaching of science than for instruction in any other school subject. Next come travel and geography, then history, social science, health, English, nature study, and commerce and industry.

The rather common use of motion picture films in the teaching of science is ascribed to the fact that more films are available on this subject than on other school subjects, with the possible exception of travel and geography. For many years laboratories also have been producing films on scientific subjects. The National Visual Instruction Survey shows that much equipment purchased with laboratory fees remains the property of the school science department. In some instances science teachers sponsor visual work in the absence of an official director of visual education, and probably favor films on scientific subjects.

Travel, geography and historical films are also available to schools from many sources, including film supply houses that make use of major studio stock shots and travelogues, travel bureaus, chambers of commerce, universities, memorial associations and frequently amateurs.

The survey indicates that if suitable films are made available schools will use them. The content of films for educational purposes is very important, however. At the

present time many films dealing with various fields of commerce and industry are available to schools free of charge, but are not widely used by school administrators and directors of visual education because of propaganda and advertising. Inexpensive and easily available nonmechanical visual aids are commonly used in today's classroom. These include charts and graphs, mounted pictures, posters and cartoons, objects, models, specimens and wall maps. The latter outnumber other visual aids used.

Education by radio and motion pictures is being woven more and more into the modern school curriculum. Survey findings show a rapid growth in the number of schools that use radio programs and motion pictures to enrich the school offerings. Larger school systems, especially, report a greater and more comprehensive use of all types of audio-visual teaching aids. Visits to libraries and museums, and field trips are also used more for visual education today than they have been in the past.

Detailed information about audio-visual aids used in elementary and secondary schools throughout the United States is included in the National Visual Education Directory, which has just come off the press and is available from the American Council on Education, Washington, D. C.

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The Seventh Annual Convention of the Biological Photographic Association will be held in Rochester, New York, September, 1937.

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Mr. Ralph Creer reports that the surgeons at the Waterbury Hospital, Waterbury, Conn., dispossessed his appendix, October 10. We are all very glad to learn that Mr. Creer's recovery was uneventful and that he is back on the job again.

Arthur W. Fuchs
343 State Street
Rochester, N. Y.

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The Journal of the
Biological Photographic
Association

IMPROVED ILLUMINATING SYSTEM FOR PHOTOMICROGRAPHY WITH IMMERSION LENSES*†

JEAN KIEFFER

Norwich, Conn.

The proper illumination of a specimen is one of the vital factors in photomicrography. The part played by the illuminating system is often much underestimated. Many different types of equipment are used for carrying out this function. The details of the illuminating system should, for the best results, be changed for practically every different objective used. It is the purpose of this paper to discuss only the proper illuminations for high-power photomicrography with the immersion lenses.

In order to produce a satisfactory photomicrograph, the image on the ground glass must be strongly and evenly lighted, free from glare, and as sharp as theoretical or practical limitations of resolution permit. This sharpness must be equal throughout the field, both in reference to position and orientation, and there must be as little color fringe as possible.

Both the image forming systems of the microscope (objective and ocular) and the illuminating system (lamp, lamp condenser, diaphragm, auxiliary lenses and substage condenser) influence the ground glass image. The limitation imposed by the image forming system cannot be changed by the best illuminating system, but a poor illuminating

* From the photographic department of the State Tuberculosis Sanatorium.
† Read at the 1936 Convention of the Biological Photographic Association.

system may make such inefficient use of the best image forming system that, as a result, the ground glass image is of very poor quality. The part played by both systems in the production of a satisfactory image is as follows:

1. *Intensity of illumination*—controlled primarily by illuminating system.
2. *Evenness of illumination*—controlled primarily by illuminating system.
3. *Resolution*—controlled by effective aperture of the combined systems. The maximum resolution obtainable is a function of the aperture of the objective used. The actual resolution obtained is a function of the efficiency with which the illuminating system fills that aperture.
4. *Freedom from directional unsharpness*—controlled by both systems, but more particularly by the illuminating system.
5. *Freedom from color fringe*—controlled by both systems, but more particularly by the image forming system.
6. *Freedom from glare*—controlled primarily by illuminating system.

The intensity of the illuminating system is of varying importance. There should be enough light reaching the ground glass to enable good focusing and to permit exposure short enough to be practicable. This limit of practicability varies with the subject and with local conditions. For living material having fast motion (blood cells, flagellates, Brownian movement), the intensity of illumination becomes of great importance for the exposure must be short. For stained specimens, the limitation is really one of adequate focusing light, provided the system is free from movement or vibrations. The intensity of the light reaching the ground glass depends primarily on the intrinsic brightness of the light source employed.

The evenness of illumination is of primary importance. It is controlled by the following factors: type of source of light, type of illuminating system, optical quality of lenses comprising the system and the alignment of optical parts. Evenness of illumination can hardly be obtained unless the system is properly aligned.

The effective aperture of the combined systems controls the maximum resolution obtained. An objective of proper aperture must be chosen and then an illuminating system capable of efficiently filling the aper-

ture with light must be used. From the writer's experience and observation failure to do this is the most common cause of poor photomicrography; the illuminating system *does not* make full use of the aperture of the objective. Of course, there are times when the full aperture of an objective should not be used, as in photographing unstained bacteria, but even then the largest aperture consistent with good contrast or differentiation of material should be used and filled with even light. Only a small percentage of the equipment seen *in use* by the writer met this requirement. The equipment may be capable of meeting it, but too often a lack of knowledge of the necessary adjustments precludes such a result.

The freedom from directional unsharpness is controlled by both the

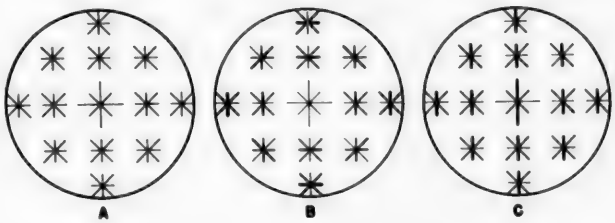

FIG. 1. DIRECTIONAL UNSHARPNESS

A. Test object.

B. Radial unsharpness. True astigmatism (approximate). The unsharpness is oriented tangentially; refocusing would produce a sharper outline of the tangential lines, and the radial lines would become blurred.

C. Axial unsharpness. Unsharpness oriented in same direction throughout field. Change of focus can not change this direction, due to aperture of light entering objective being smaller in one direction than in another.

image forming system and the illuminating system. For our purpose we intend directional unsharpness to mean a defect where the photomicrograph is sharper in one direction than another, either locally or generally. Poor correction of the image forming system, for example, the use of an ocular unsuited to the objective, will often produce a local effect. The edges of the field will be sharper in one direction than in another and the orientation of the unsharpness will change as the position relative to any axis of the picture changes. (True astigmatism, Fig. 1B.) This type of defect cannot be corrected by the illuminating system, but very often a well corrected image forming system produces an image which shows a lack of sharpness in one direction throughout the field (Fig. 1C) and the direction of this unsharpness does not change

during focusing. An objective aperture not evenly filled with light is the cause; the full aperture of the objective is used in one direction and only part of it in another. The illuminating systems using Mazda lamps, in which an image of the filament is projected in the back lens of the objective, are very prone to this defect. (A somewhat similar defect is also evident when using polarized light through an analyzer of the prism type, but the direction of the unsharpness changes as the focus is changed. It is due to axial astigmatism and is inherent to the analyzer, hence to the image forming system, and can only be corrected by the use of special correction lenses mounted on the analyzer, as is done in the better instruments.

The freedom from color fringe is controlled almost entirely by the image forming system. All combinations of oil immersion objectives and oculars investigated by the writer show some color fringe at high magnifications. A well corrected apochromatic objective with its compensating ocular will show a minimum of fringe. This slight fringe is usually due to residual chromatic differences of magnification. All achromatic objectives will show a definite color fringe, principally due to chromatic aberration. When sharp cutting filters are used while exposing the plate this defect is of little consequence so long as the image is focused by that light, but for color work it is of paramount importance that it should be reduced to a practicable minimum. The best combinations found by the writer are the Zeiss apochromatic oil immersion lenses used with the Homal III. The Zeiss company recommends the Homal IV, which has a somewhat flatter field and is suitable for black and white work with filters. However, the Homal III shows much less chromatic differences of magnification and has proved better for color work.

The effect of the illuminating system on color fringe is not marked. It cannot correct this fringe but may intensify it. If the cone of light entering the objective already has marked chromatic aberration, the condenser will be in focus for only one color and its aperture will be completely filled by the light of only that color. Lights of other colors will fill the aperture to a lesser extent with consequent loss of resolution for these colors. The unsharpness thus produced will depend on many factors, such as the color of the object, the amount of chromatic aberration in the illuminating beam, the color of light for which the condenser is best adjusted, etc. A good illuminating system should have only a

small amount of chromatic aberration; a perfect one, none. The last mentioned condition could only be reached with extremely expensive equipment; for practical results only the substage condenser must be of the achromatic type. This type of condenser is usually also aplanatic, a distinct advantage for reasons quite similar to those above outlined; the focus of the condenser does not change with varying apertures. Such an achromatic condenser should always be used for color work. A color corrected lamp condenser is also desirable, particularly if it is of large dimension.

The freedom from glare is largely controlled by the illuminating system. Fog or haze caused by leaky bellows, reflecting surfaces in the shutter leaves or inside the camera, leaky connections between microscope and camera, or dust on the optical surfaces, are outside our subject and will not be discussed. The glare which concerns us is that produced by light reflected or refracted back on any part of the ground glass image by the various components of the optical systems and which does not proceed from the part of the object whose image is formed at that place.

The illuminating systems in general use can be divided into two types. The older one, the Abbe system, also called the Nelson system, consists of a source of light, a condensing system to concentrate the light and a substage condenser. (Fig. 2, Dia. 1.) Many variations of this arrangement have been used, but the main principle is that an image of the source of light is projected on the object field. This image thus becomes the radiant field. Obviously, such a system is satisfactory only when the source of light, or at least some part of it, is large and homogeneous enough to give a satisfactory distribution of light on the radiant field, like the crater of an electric arc, the gas mantle, the wick of a kerosene lamp, or the calcium cone, extensively used with the older outfits. The image of the source of light is usually thrown slightly out of focus to compensate for minor irregularities, such as the web of a gas mantle. No field stop can be used with this system, though diaphragms acting approximately in this capacity have been used directly in front of the illuminant. The aperture is controlled by the substage condenser diaphragm. Since the image of the primary condenser is usually near the back lens of the objective, the full aperture can generally be used with practical freedom from directional unsharpness. The limitations of such a system are that the absence of a true field stop produces a

large amount of glare from the part of the field illuminated but not recorded, and that it is very difficult to obtain even illumination. When large condensing lenses were employed (and in the early days this was common practice), the chromatic correction of the system was very bad; of course, the use of filters minimize this defect and many very fine

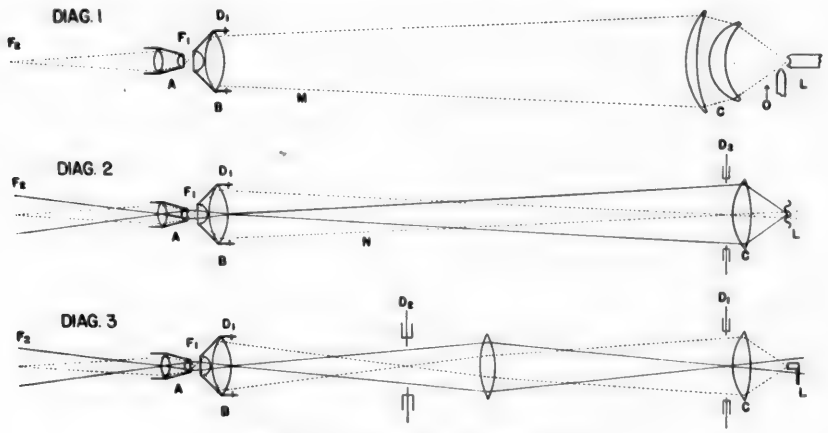

FIG. 2. ILLUMINATING SYSTEMS

A—objective; *B*—substage condenser; *C*—lamp condenser; *D1*—diaphragm acting as aperture diaphraghm; *D2*—diaphragm acting as field diaphragm; *F1*—front focal plane of objective, focal plane of condenser; *F2*—back focal plane of objective, front focal plane of eyepiece.

For the purpose of clarity, accessories such as collimating or centering lenses, as well as water-cells or filter holders are not shown.

The Abbe system (Dia. 1.) usually has a collimating lens near M for substage condensers corrected for infinity. When using a wide source of light such as the gas mantle, an approximation of a field diaphragm is obtained by inserting a stop of the proper size at O.

The Kohler system (Dia. 2.) usually has a centering lens near N which also acts as a correcting lens suited to the particular condenser used.

In the system described in this paper (Dia. 3.) the substage condenser itself is in a centering mount, permitting the field diaphragm to be brought to the exact center of the objective field. The distance from condenser to field diaphragm is such that no correcting lens is needed with Zeiss achromatic condenser. If a condenser corrected for infinity is used, a correcting lens should be introduced near the condenser.

black and white photomicrographs have been taken with such a system. However, it is entirely unsuited for color work.

The newer system, that of Kohler, which is the one almost universally used at the present time, consists of a source of light, a primary condenser and diaphragm, and a substage condenser and diaphragm. (Fig. 2, Dia. 2.) Other accessories, such as collimating or centering lenses,

are often used to improve the correction of the system but are of minor consideration. The main principle of this system is that an image of the primary condenser diaphragm is thrown on the object field; this diaphragm thus becomes a field diaphragm. Since it is placed very close to the primary condenser, the light passing through is very even, and as a result the radiant field is evenly illuminated and of controllable size. An image of the light source is thrown on or near the back lens of the objective. The primary condenser is of such focal length that the image of the light source fills this back lens, thus making the use of the full aperture of the objective possible. When the light source is even and nearly circular, such as an electric arc or Point-O-Lite lamp, this system is quite satisfactory because the back lens of the objective is filled with fairly even light and no directional unsharpness is noticeable. However, when a light source of uneven luminosity or of a shape differing markedly from circular is used, as in filament lamps, very

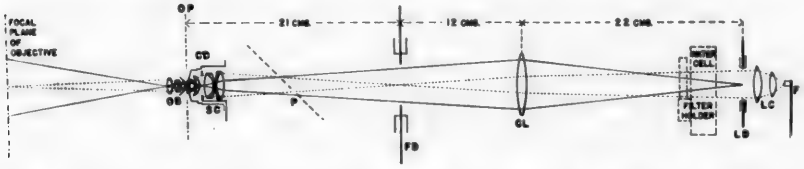

FIG. 3. DIAGRAMMATIC REPRESENTATION OF LIGHT PATH THROUGH IMPROVED ILLUMINATING SYSTEM

marked differences of resolution for various orientations will appear, due to the fact that the illuminating beam makes use of the full aperture of the objective in one direction only. If the primary condenser focal length is changed so as to throw a very large image of the source of light on the back lens, and only a fairly homogeneous part of this image is used, this directional unsharpness can be minimized. However, glare is then likely to appear because much unwanted light is thrown in the system, and it is therefore not wholly satisfactory for such light sources.

A method combining the advantages of the two systems above described and obviating their disadvantages has been in use by the writer for the past three years.

During the development of a satisfactory technic for color photography the shortcomings of the above systems became very apparent, particularly since it was felt desirable to use Mazda illumination on account of the relative constancy of intensity and color of the light

it emits. As the work progressed it became evident that the flat ribbon filament Mazda lamp was the most satisfactory illuminant, but the illuminating systems tried did not prove entirely satisfactory for the reasons previously described. Many variations were tried until the following system was developed and found highly satisfactory.

This system (Fig. 3) consists of a light source (F), a lamp condenser (LC) and its diaphragm (LD), a positive lens (CL), a field diaphragm (FD) and a substage condenser (SC), used in such a way that an image of the filament (F), produced by the lamp condenser (LC), is thrown onto the plane of the diaphragm (FD) after passing through the positive lens (CL). This image combined with that of the field diaphragm is then focused upon the object plane (OP) by the substage condenser. The positive lens (CL) is placed in such a position that it forms an image of the lamp diaphragm (LD) on the diaphragm plane (CD) of the substage condenser. This image is then reformed on the back lens of the objective (OB) after passing through the substage diaphragm and the front lenses of the objective, thus diaphragm (FD) serves as a field diaphragm, and lamp diaphragm (LD) as an aperture diaphragm. The radiant field is formed by a sharply focused image of the filament, this image being large enough to require the use of the central part only and produce an evenly illuminated radiant field. The size of this field is controlled by the size of the opening of the field diaphragm, the light coming from the unused portion of the filament being cut out at the field diaphragm. The introduction of the positive lens (CL) making an aperture diaphragm of the lamp diaphragm, provides an even illumination of the back lens and eliminates the rest of the unwanted light at the source. With this system properly adjusted, and particularly with both the condenser diaphragm (CD) and the lamp diaphragm (LD) closed until their outline is barely seen in the back lens of the objective, and with the field diaphragm (FD) opened sufficiently to cover the desired field, only the light that is needed to illuminate the radiant field at the proper size and aperture will reach the substage condenser and the glare will be reduced to a minimum. The only glare produced is that coming from some part of the radiant field. This glare can be controlled only by the proper design of the objective lens. The amount of light reaching the plate is adequate for all work except that requiring the stopping of fast motion. The exposures are in the order of one to four seconds for magnifications of 1200 when using a slow emul-

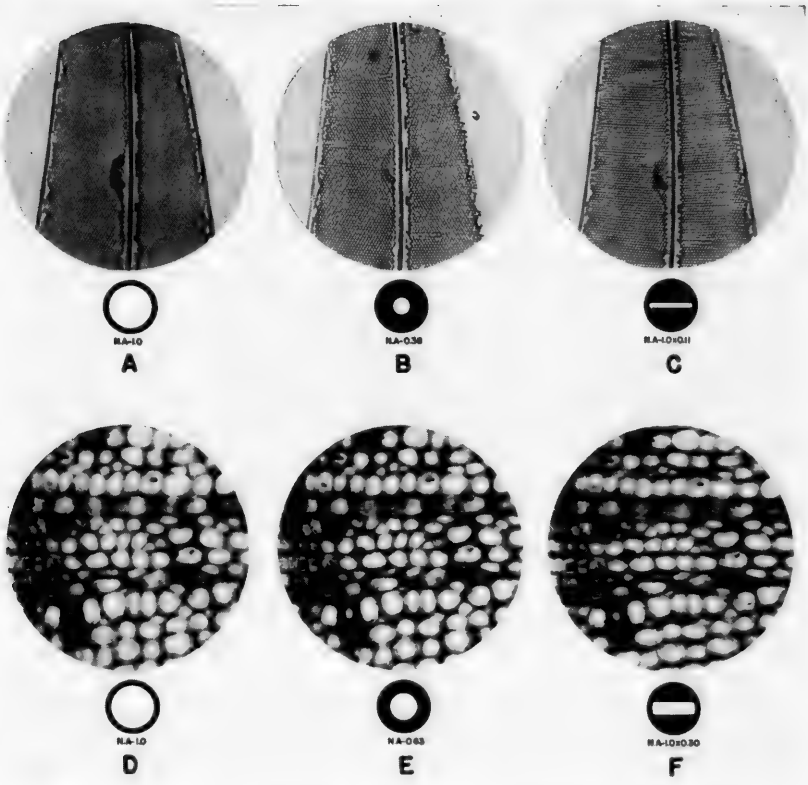

FIG. 4. A, B, C. UNSTAINED SPECIMEN—"PLEUOSIGMA ANGULATUM"

A. Effective aperture, circular N.A. 1.0. Illuminating beam fills back lens with even light. Maximum resolution. No directional unsharpness.

B. Effective aperture, circular N.A. 0.3. Illuminating beam does not fill back lens. Lamp and its condenser too far from microscope. Marked increase in contrast, but resolution lessened. This is particularly noticeable where there are defects in the object pattern. No directional unsharpness.

C. Effective aperture, rectangular N.A. 0.11. × N.A. 1.0. Illuminating beam fills aperture in only one direction. In this case, a narrow rectangular stop was introduced in the illuminating beam in order to emphasize directional unsharpness produced. Area of aperture equal to that of B. Exposure unchanged. Focus unchanged. Notice the change of pattern which has taken place due to the distortion produced by unequal resolution along two axes.

D, E, F. STAINED SPECIMEN—CELLULAR STRUCTURE OF TWIG

D. Effective aperture, circular N.A. 1.0. Maximum resolution shown by fine detail.

E. Effective aperture, circular N.A. 0.63. Increased contrast and increased depth of focus. Resolution lessened. This is, perhaps, the best compromise for a photomicrograph of this type.

F. Effective aperture, rectangular N.A. 1.0 × N.A. 0.30. Area of aperture equal to E. Exposure equal to E. General appearance also similar to E except for lengthened appearance of cells due to directional unsharpness and varying depth of focus along two axes. Uneven illumination of back lens due to filament image on back lens of objective.

sion of the Wratten M. plate type and a filter combination of B & G for black and white; the exposures for color work on screen plate or films (Agfa, Dufay, Finlay) are in the order of one to eight seconds.

It can therefore be seen that this system meets the criteria for a satisfactory illuminating system. First, the light is adequate. Second, the radiant field is controllable in size and evenly lighted. Third, the aperture angle of the illuminating beam is controllable. Fourth, the back lens of the objective is evenly lighted. Fifth, with the use of an achromatic condenser, the chromatic correction is adequate. Sixth, glare is practically absent because all the light not needed is cut out before it reaches the substage diaphragm.

Another advantage of such a system, though one which does not affect the quality of the image, is the ease with which one may go from high intensity to a visual beam without disturbing any adjustments and with the field diaphragm in use. The last mentioned feature has been found of great advantage as it permits easier centering of the field or of the various objectives by having, at all times, an image of the diaphragm on the objective plane. It also permits much easier finding of the object after changing the objectives as one merely focuses for the diaphragm image instead of the object, an invaluable asset while working with very thin or unstained specimens. The final focusing is, of course, done on the specimen.

The change from high intensity to a visual beam is made by introducing a mirror in front of the lamp. This mirror reflects the light from a suitably placed small light onto the optical axis of the illuminating system. No filters need be removed or changed, nor is it necessary to make any other adjustment in the high intensity beam. It need not even be turned off.

The special characteristics of the components of this system are as follows:

F—Flat ribbon filament Mazda lamp, 18 amperes 6 volts. Energized through a transformer and rheostat control permitting variation of voltage from 4.2 to 6.2 volts. Working at 5.4 volts it has proved very satisfactory, and increases the life of the lamp markedly while the emitted light is still of adequate intensity. This voltage also gives a good color of light for color work.

LC & LD—From a Bauch & Lomb research microscope lamp. LC of approximately 2 cm. equivalent focus with chromatic and spherical aberration fairly well corrected, LD of 29 mm. aperture.

CL—125 mm. focus spectacle lens of 60 mm. diameter, mounted with a shield.

FD—Iris diaphragm. Minimum aperture of one millimeter in order to permit a very small field for centering. Maximum aperture need not be over 40 mm.

SC—Zeiss achromatic aplanatic condenser, N. A. 1.4 in centering mount.

The system is mounted on a properly aligned and centered optical bench. In our routine equipment a prism is introduced between the field diaphragm and the substage condenser (at P. Fig. 3) for use with a vertical camera. In an illuminating system of such high correction, only a prism or a first surface mirror should be used. The introduction of an ordinary mirror gives rise to a multiplication of the field diaphragm image, which is very disturbing and introduces glare.

The spacing of the various components is shown on the diagram.

In conclusion, it is emphasized that this system is particularly suited for photomicrography through immersion objectives and especially for color work. Such a system can be used for work with other objectives but the optical characteristics of each component and their spacing should be changed to fit the focal length and aperture of the objective used. The system as described is suitable only for objectives from 2.5 to 1.5 mm. equivalent focus and up to 1.4 N. A. and for object fields up to 100 microns diameter. Larger object fields would not be evenly illuminated as the edges of the filament image would impinge on them. Within such liminations this illuminating system has proved eminently satisfactory.

THE PHOTOMICROGRAPHY OF BLOOD*†

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We picture blood as dried spreads on glass, not as greenish-yellow, bell shaped and pale globular bodies floating in plasma, the red and white corpuscles in fluid blood. The red cells are quite small, averaging 7.5

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† Read at the 1936 Convention of the Biological Photographic Association.

microns in diameter; the leukocytes or white cells are larger and of several different types, varying from 7.5 microns to 20 microns or more. The platelets are small, roundish elements found on spreads in groups, resembling bunches of grapes, and measuring about 3 microns. The degree of coloring in the red cells depends upon the amount of hemoglobin. In well mounted specimens the centers of the cells are always paler than the periphery. In anemia the cells are pale, and an increase in anemia frequently causes an increase in the pale central area from loss of coloring matter. Often there is only a narrow rim of hemoglobin remaining. In pernicious anemia, however, the red cells are mostly oversized and highly irregular in shape and filling. While anemia may be less interesting from the photographic standpoint, giving pale, washed-out prints, such results are a true rendition because blood in anemia cannot be made to look otherwise. Our studies are mainly of the pathological changes in blood and blood-forming tissues, and deal more often with the white cells. The conformation and structure of their nuclei are important points in the differentiation of various types of white blood cells and in the determination of the stage of their maturity.

Blood cells have little character unless stained. The staining is for contrast and to bring out detail. The photography is done through the microscope and the colors, that is, the contrast and details, are shown by transmitted light.

The stains regularly used for blood are the so-called Leishman[1] type and are essentially mixtures of red, blue and purple values, made by mixing in solution eosin, a yellowish-red acid dye, with methylene blue, methyl violet, methylene azure and other basic analine dyestuffs, to make a so-called polychrome stain. Numerous new compounds (eosinates) are obtained and a complex mixture is the final result. When blood is stained by the use of some one of these variants of the original Leishman mixture the red cells become pink, and the white cells, which contain nuclei and some of them granules as well, are distinctly colorful and gay. The nuclei show various shades from royal purple to bright magenta, and the granules perhaps red, rose, blue or purple in pale blue cell bodies. The platelets are pink and purple, like the grapes their clusters resemble. Through the microscope these colors show bright and dark by transmitted light.

We must record these stained blood spreads photomicrographically either by (1) transference of these colors into black and white half-tone contrasts, without loss of detail, or (2) in natural color.

At this time let us deal with the problem first mentioned, transference of these colors into black and white half-tone contrasts as the human eye sees them and without loss of detail. A number of essentials are involved, namely:

(1) The use of the yellow-green spectral band for illumination
(2) The use of a film that is blind to red in order to give a substantial record to the pale pinks so easily lost
(3) The use of a filter to darken the blues
(4) The use of a specimen so stained as to have purple to magenta coloring in the basic, bluish staining elements, and rose-pink in the acid or red staining elements.

Our results show that by using the yellow-green band the blue of the rose-pink gives detail to the reds, the red in the purplish-blues gives additional detail, and the magentas and purples, being complimental to parts of the yellow-green band, give maximum contrast. There still remain in the full width of the yellow-green band borderline wave lengths which give the detail so essential to fine results. This conforms to the general rule that for contrast use the complimental light; for detail, the bordering wave lengths. It often happens that invisible detail is recorded photographically.

The necessity for cooperation with the clinical laboratory technician is obvious, because clean, well spread and properly stained smears are essential to good photography. Far more important is the cooperation of the hematologist. As biological photographer at the College of Medicine, Syracuse University, the author has been extremely fortunate in an association where considerable research work is being done on diseases of the blood. This naturally leads to an excellent understanding of stains and staining principles. The Groat-Jenner[2] stain, a modification of the Leishman stain, was developed at Syracuse University and has been used there for many years. It is sufficiently elastic to cover various needs and may be modified to produce staining effects best suited to photography, using the yellow-green band.

But why use the yellow-green band and what is the best way to obtain and utilize this band?

The matter of true color values in the source of illumination is important only in color photography, so either carbon arc or tungsten bulb can be used satisfactorily since each is rich in the wave lengths we need. Both sources of light have been used but at present the arc is preferred.

If we consider the retina of the eye as a sensitive film then we may say

it is highly sensitive to the yellow-green and decreasingly sensitive toward the red and the blue. The result is that the yellow-greens are "bright" and the blue and reds "dark," with transitions between. The ordinary photographic film is highly sensitive to the blue and to a lesser degree to the yellow-green, making the blues and violet essentially

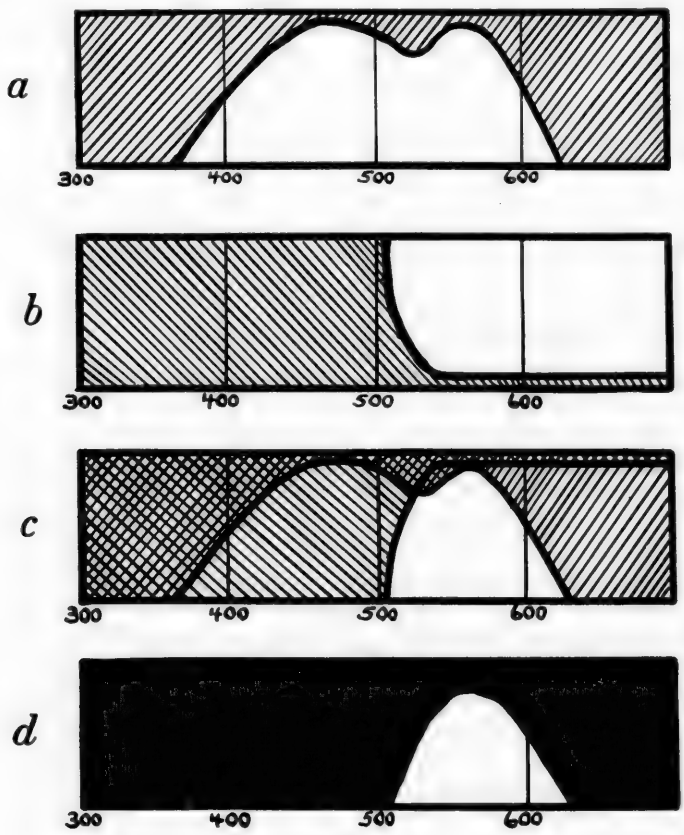

FIG. 1

"bright" to it. Orthochromatic film is somewhat more sensitive to yellow-green than panchromatic film or any other common type. This is one of the reasons we use the Eastman Commercial Orthochromatic film. A maximum of yellow-green in both light and sensitivity is desired.

Our choice of filters is the Wratten G (No. 15). For off stains, Wratten filters Minus Blue (No. 12), B2 (No. 58) and possibly the K's may be

used. However, as in photography in general, trying to offset or correct by the use of filters often intensifies the fog on the resulting negative.

Fig. 1 shows the manner in which we worked out the theory. Parts a, b, and c of this figure were adapted from those in "The Photography of Colored Objects"[3] and "Wratten Light Filters"[4]. Part d of the same figure is a diagram of a wedge spectrum taken on Eastman Commercial Orthochromatic film through the Wratten G filter (No. 15).

Part a of figure 1 shows the spectral sensitivity of the Orthochromatic film. The wave lengths represented are violet through blue, bluish-green then green, yellow, orange and finally red, to which the film is practically blind.

Part b shows the spectral transmission of the Wratten filter G (No. 15). All light is cut off just beyond 500 mμ toward the violet, except for a small band around 300 mμ, which is in the invisible spectrum and is not shown on this diagram. Transmission begins in the blue-green and rapidly increases to a maximum for green, greenish-yellow and on through the red.

Part c shows the superimposition of these curves. The transmission of the G filter is reversed so that the two curves may be combined. It will be noted that the dip in the sensitivity of the film from 500 mμ to 550 mμ is touched by some of the diminished transmission of the filter and modifies the result, pushing the curve over toward the yellow-green.

To obtain the fourth figure, the author wrote to Mr. Loveland of the Photomicrographic Department, Eastman Kodak Research Laboratories, and asked if he could furnish a wedge spectrum of transmission of the G filter on Commercial Orthochromatic film. The author is very much indebted to Mr. Loveland for having this made for her. Mr. Loveland's description of the result accompanying the original print of the wedge is as follows: "The wedge shows a sharp maximum at 560 millimicrons and an intensity so great in the central portion that the scale is obliterated." It therefore shows the actual photometric result. It is important to note that the point of greatest intensity, at 560 mμ, is close to the point of average maximum sensitivity of the human retina and symmetrically diminishes toward the red and the blue, in much the same way that the retina decreases in sensitivity, expressed as "bright" and "dark". We believe this to be an important factor in obtaining a correct transference of the colors into half-tone values as the human retina translates them.

Fig. 2 shows the position of the absorption bands. The magentas, purples and violets absorb the green, which means they will look dark and produce the contrast we must obtain. The blood has been stained with these colors so that it will look dark to the eye. Dyes give narrower absorption bands than natural colors. Since we have contrast, we also obey the general rule by having enough width in our yellow-green band to give detail as well as contrast.

With correct illumination, filters and film, proper alignment and rigidity of apparatus, good apochromatic optical system, and properly

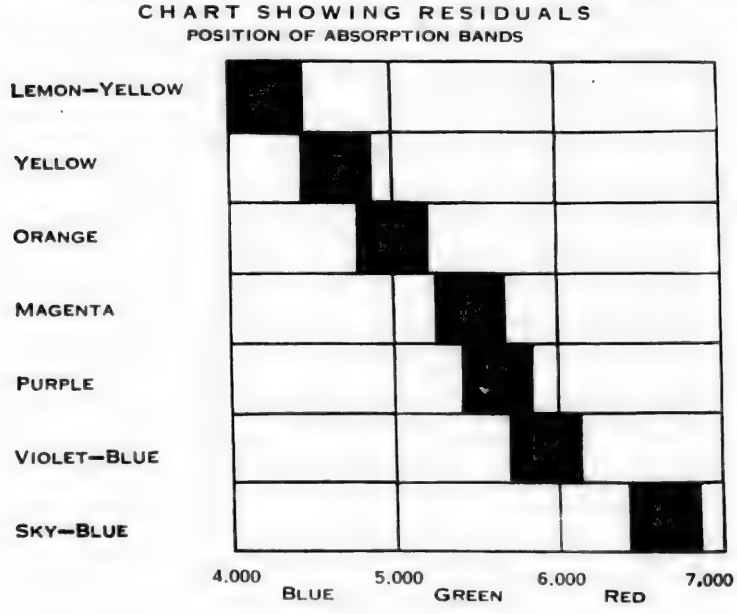

FIG. 2

stained smears, satisfactory results will follow. We may then use an oil immersion apochromatic objective of a numerical aperature of 1.32, an 8 × ocular and a bellows length of 37 cm. to reach a magnification of 1200 diameters with clear definition. In this manner we translate the colors into optical effects of black and white. Those who are interested in the examination of blood smears find these shades satisfactory and useful because they give the visual effects of bright and dark values similar to the tone values seen through the microscopes[5].

I wish to acknowledge my indebtedness to Dr. William A. Groat,

Professor of Clinical Pathology, College of Medicine, Syracuse University, for his interest and many helpful suggestions in developing these ideas for the photomicrography of blood.

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DEPTH OF FIELD IN PHOTOMICROGRAPHY*†

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It might be assumed that a paper presented before the Biological Photographic Association would deal with biological accomplishments that have resulted through the agency of photography. These accomplishments have been so admirably treated elsewhere, however, that for the sake of keeping our perspective it may be well to consider here a limitation that photography will find difficult, if not impossible, to remove. Since the present discussion applies to ordinary photography quite as much as to photomicrography, it is more convenient to begin with a consideration of the depth of field when large objects are being photographed.

In Figure 1 let P represent a point of the object that is to be photographed. A portion of the light diverging from P will enter the lens or optical system located at O. The details of this optical system have been purposely omitted because, as will be clear presently, they are quite irrelevant in this connection. It will suffice to assume that a divergent pencil of rays whose half angle is Θ is converted by the optical system

*From the Department of Physics, Massachusetts Institute of Technology.
†Read at the 1936 Convention of the Biological Photographic Association.

into a pencil converging toward the point P′ having a half angle Θ′. A photographic emulsion located in the plane of P′ will evidently record an image of the point P. Indeed, every point on the surface of the emulsion will be the image of some point in the object space. If the photographic emulsion is flat and the optical system is without aberration, a critically sharp picture can be made of one plane in the object space.

The above reasoning is based on geometrical considerations which take no cognizance of the wave nature of light. When the problem is treated more comprehensively it is found that even with a perfect optical sys-

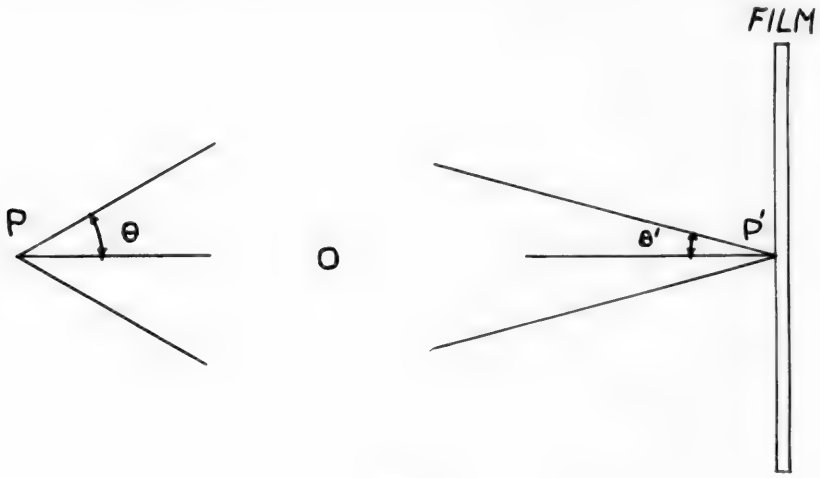

FIG. 1

tem the image at P′, instead of being a point, approximates a circular disk of light. The diameter of the circular disk depends upon only two factors—the wave length of the light used to form the image and the size of the angle Θ′. Reduction of the wave length of the light decreases the diameter of the circular disk, whereas a decrease in the value of Θ′ increases the diameter of the circular disk. Such reasoning leads to the conclusion that, with the light of a given wave length and an optical system that is perfectly corrected, the image of a plane through P will not be absolutely sharp. Instead the sharpness of the image will depend upon the value of Θ′; the larger the value of Θ′, the sharper will be the image.

The above considerations are necessary in order that the depth of field may be examined under conditions that are truly comparable. With the optical elements used in photomicrography it is not unreasonable to assume an optical system that is perfectly corrected. Since the quality of the image is in this case limited only by diffraction, the value of Θ' may be regarded as establishing a criterion of image quality or sharpness.

It is evident from Figure 1 that the effect of moving the photographic emulsion toward O would be to cause the mathematical point at P′ to become a circle of ever-increasing diameter. This follows from purely geometrical considerations. Since the theory of diffraction indicates that the image of a point is always a disk of finite diameter, it follows that, under a given criterion of sharpness, the photographic emulsion can be moved a short distance toward O without causing an appreciable effect on the quality of the image. In a similar manner, if the emulsion were moved away from O a certain displacement could be tolerated without producing a noticeable effect on the image quality. For convenience let d represent the total distance through which the photographic emulsion could be moved longitudinally without causing an apparent effect on the quality of the image. A longitudinal movement of the emulsion has the effect of bringing other planes of the object space into the best focus. Thus the conjugate object plane may be conceived to move longitudinally a distance D in conformity with a displacement d in the image space. A fundamental principle of optics states that

$$D.m^2 = d$$

where m is the lateral magnification between the object and its image. Now D in this case is the depth of field in the object space and d is the depth of focus in the image space. Since the depth of focus is fixed by the criterion of image quality, we may conclude that under comparable conditions the depth of field in the object space is inversely proportional to the square of the magnification.

To realize the limitation that this result imposes on the results obtained by photomicrography, consider the problem of photographing a very large object, for example, an elephant. In this case the picture of the elephant will ordinarily be much smaller than the elephant. This means that m is less than unity and the depth of field for a reasonable

criterion of image quality will be great. Now suppose the elephant is replaced by a baby elephant whose linear dimensions are just half as great as those of the adult elephant. We shall undertake to make a picture of the same size and the same image quality. This means that the magnification m will be twice as large as it was previously but the value of d will be unchanged. As a result the depth of field in the object space is only one-fourth of its former value. The next step is to imagine the animal to continuously shrink in size. Every time that the linear dimensions of the animal are halved the depth of field is reduced to one-quarter. A limit will presently be reached in the size of the animal that can be photographed under a specified criterion of image sharpness. Since this conclusion is reached without making any assumption concerning the details of the lens or optical system, it follows that this conclusion applies to all optical systems. In other words, if the depth of field in a photomicrograph is inadequate when the photomicrograph has been made by using the smallest value of Θ' that will supply the necessary sharpness, it is then of no avail to try other combinations of optical elements. No improvement in depth of field is possible except for the slight benefit that can be obtained from the use of light of shorter wave lengths.

It is so often claimed that a particular lens or optical system results in an enhanced depth of field that a brief discussion of the basis for such conclusions may not be out of place. If the aberrations afflicting an optical system are imperfectly corrected, the diffraction disks are masked by the blur circles resulting from the uncorrected aberrations. This reduces the image quality and corresponds to the assumption of a smaller value of Θ' or a larger value of d. Since D is increased in proportion to d, the inferior optical system seems to enable a greater depth of field to be secured. Actually an inferior image quality is being tolerated. In the absence of a picture of higher quality for comparison the lack of image quality may not be noticed.

It should be noted that the basis of comparison that has been here assumed, although reasonable in the case of photomicrography, is scarcely justified in the field of ordinary photography. This is due to the fact that ordinary photographic objectives are very poorly corrected in comparison to microscope objectives. In other words, even at the smallest stop a photographic objective will ordinarily yield sharper images than when it is used "wide open." This means that the aberrations

and not diffraction are controlling the image quality. Under these circumstances it seems fairer to base comparisons of depth of field on the assumption that the photographic emulsion is to receive equal illumination in all cases. Since the illumination of the emulsion depends upon the value of Θ', such an argument leads to the same conclusion that, for a given magnification, all lenses have the same depth of field. It is advantageous in this case, however, to make a small negative and then to enlarge it subsequently. This procedure is of no avail when the image quality is limited by diffraction, as it is in photomicrography.

The conclusion to which this investigation leads is that, in all critical work where diffraction limits the image quality, all optical systems are equally able to provide depth of field. This conclusion is, of course, borne out by experiment but there is some satisfaction in having a theoretical basis for the conclusion. Otherwise, one is always left with the feeling that a more skillful technic might enable a greater depth of field to be attained. It should be remarked that these considerations do not apply to the visual use of a microscope. Not only is the involuntary power of accommodation which the eyes possess of some assistance, but the ability of the microscopist to watch the image as the microscope tube is racked up and down makes even the concept of depth of field vanish. With continued study the microscopist is able to build up in his brain a mental image of a three dimensional object. If skillful the microscopist can make a drawing as a means of representing his mental image to others. Such procedures provide the only methods of studying objects that cannot be satisfactorily represented by photography.

A FILM EMULSION FOR MAKING DIRECT DUPLICATES IN A SINGLE STEP*†

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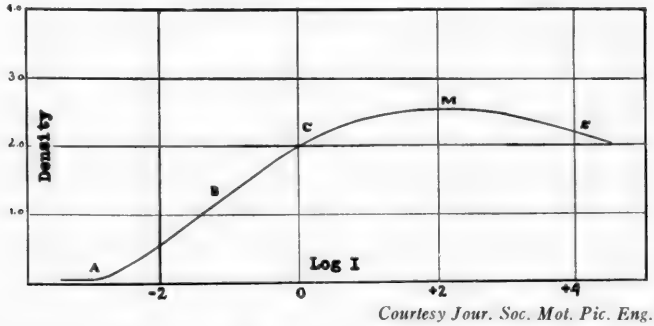
The personnel and facilities of most medical photographic laboratories are so taxed with the ever-increasing interest and demands of the profession, that any new method which will facilitate the technical procedure in

* From the Agfa Ansco Corporation.

† Read at the 1936 convention of the Biological Photographic Association.

the laboratory should prove interesting to those engaged in this work. This paper is, therefore, submitted because it deals with a film which permits making direct duplicates in one step. It is new and interesting and, we believe, holds great promise for the simplification of general photographic procedure.

This new film emulsion is of a silver bromide composition similar to other photographic emulsions, but its characteristics and reactions are directly opposite. A sheet of this film when developed and fixed without exposure is completely black, whereas a sheet of any other film that is handled in like manner is clear. A sheet of this film processed after heavy exposure is clear, whereas any other film similarly exposed, developed and fixed is black.



Courtesy Jour. Soc. Mot. Pic. Eng.

FIG. 1. Characteristic curve taken from the time-intensity-density surface of the extra-rapid plate.[1]

Figure 1 represents a characteristic density-log exposure curve for an ordinary photographic silver halide emulsion normally exposed in a sensitometer and developed in a common metol-hydroquinone developer. Only the portions, A, B and C, known respectively as the toe, straight line and shoulder portions of the curve, have been of practical value and importance in photographic emulsions, whereas portions M and especially S are undesirable in any emulsion, because the registration of the light values in these parts of the characteristic curve are distorted.

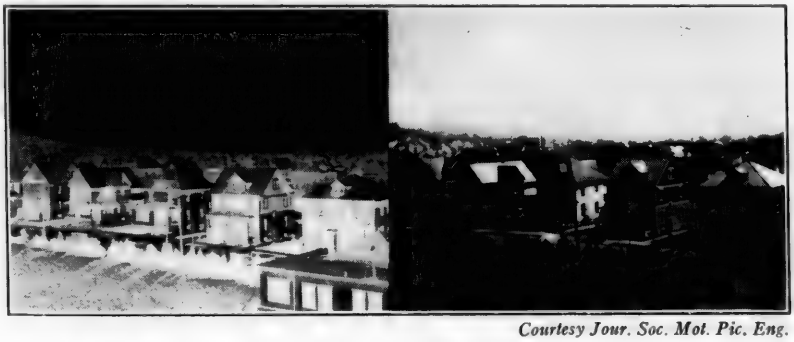
The emulsion of the Direct Duplicating film now makes practical use of part S of the characteristic curve, or the solarization portion. The effect of exposure here is exactly the reverse of the effect on the A, B and C portions. Before the maximum density M is reached, the density of the developed silver image increases with an increase in exposure. Within the solarization the density decreases with an increase

[1] Manufactured by Agfa Ansco Corp.

in exposure. In other words, a print made from an original negative using only the solarization part will be negative, and a print from an original positive will be positive in either case, therefore a duplicate of the original.

Figure 2 illustrates the practical results with an emulsion of this kind. In the negative on the left, Super Plenachrome film pack was used: in the positive on the right, Direct Duplicating film was used. Both films, after being exposed in a camera, were developed and fixed together in the same solutions. The application of the same technic results in the usual negative in one case and a duplicate in the other.

There are occasions in photography when, quite accidentally, practical duplicates are obtained due to a very great overexposure given to an ordinary emulsion, but this is the first time that the phenomenon of



Courtesy Jour. Soc. Mot. Pic. Eng.

FIG. 2. *Left:* Negative—Super-Plena-Filmpack—*f*/11, 1/50 second. *Right:* Positive—Direct Duplicating film—*f*/4.5, 10 seconds. After exposure in the camera, both films were developed and fixed together in the same solution (Rollfilm developer: negative, 3.5 minutes; positive, 3 minutes).

solarization has been put into practical use. In order to produce the solarization effect it is necessary to choose carefully the emulsion, because some emulsions show greater susceptibility to solarization than others. Furthermore, it is necessary to expose the emulsion up to the point M of maximum density, a procedure which is not very practical. However, in most cases it turns out that the characteristic curve is not sufficient for practical use, because the film does not show an adequate clearness and the density range obtained in the part of the solarization is not sufficient. All of these difficulties have been overcome in the Direct Duplicating film. The general photographic qualities, such as clearness, gradation, etc., are such that the film is of real practical value.

It can be seen from Figure 3 that the general speed of the Direct

Duplicating film is slightly below that of Convira paper, and therefore requires more exposure.

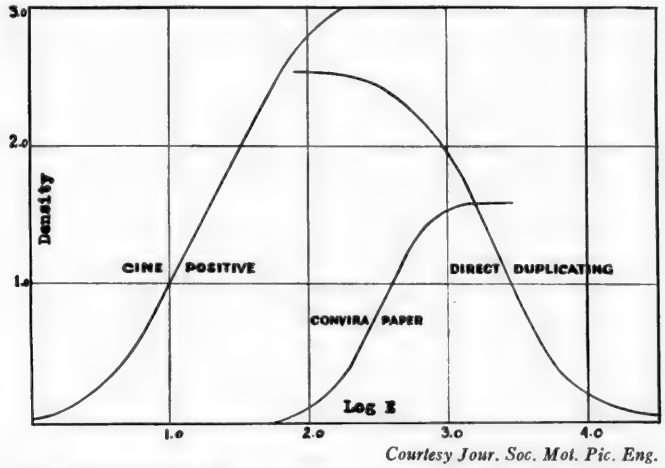


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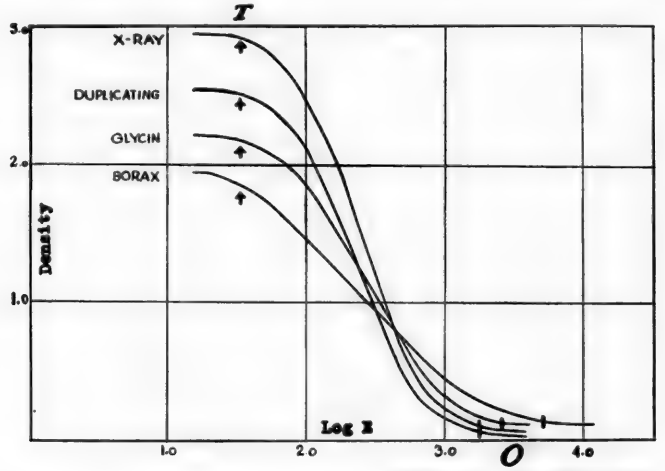
FIG. 3. Characteristic curves:

Film	Development Time	Developer
Positive 35-mm	4 min.	Positive
Convira paper	2	Paper
Direct duplicating	6	Direct duplicating



Courtesy Jour. Soc. Mot. Pic. Eng.

FIG. 4. Characteristic curves of Direct Duplicating film, developed in Direct Duplicating film developer for 4, 6, and 8 minutes at 65°.

Figure 4 shows the sensitometric curves for different developers. The threshold speed indicated at the point T is the same for all devel-

FIG. 7

FIG. 6

FIG. 5

opers. There are considerable differences in the gradations, such as −1.1 for borax developer and −3.1 for X-ray developer. The range of exposures registered by differences in density vary, as indicated by the distance along the abscissa from points T to points O. The illustrations of chest radiographs in figures 5, 6 and 7 indicate the different effects that may be procured by using different developers. Figure 5 shows the result of using a soft developer, such as borax. Figure 6 shows the result of using a medium Direct Duplicating developer, and figure 7 shows the contrasty result of using X-ray developer. These differences are much more noticeable in the original films.

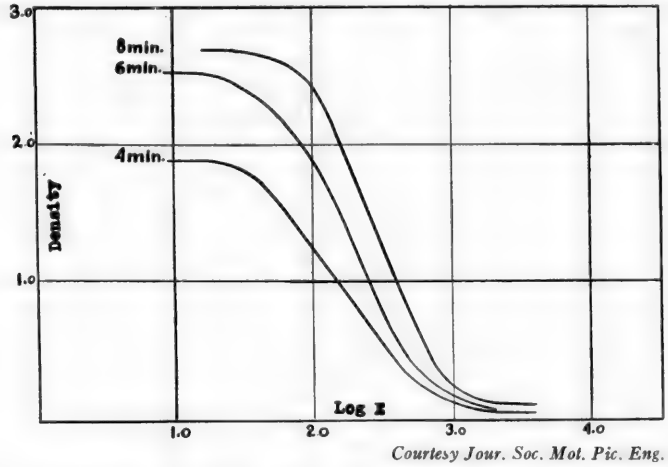


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FIG. 8. Sensitometric curves of Direct Duplicating film for various developers:

Film	Minutes
X-Ray	5
Direct Duplicating	6
Glycin	12
Borax	20

(*See Table II.*) The curve for amidol developer, 8 minutes, is practically identical to the curve for glycin, except for the higher fog of 0.2, instead of 0.15 for glycin.

Figure 8 shows that the gradation of the Direct Duplicating emulsion changes with the developing time in the same way as the normal type of film. There is an increasing gamma when the developing time is prolonged from 4 to 8 minutes, as this slide well illustrates.

Considerable experimenting has been done with various developers for the direct duplicating film. Table I shows some of the more important results, while Table II describes the developers used to attain them.

The method of making this emulsion is based upon the idea of replacing a preliminary exposure by a special ripening process. In the first place, a normal photographic emulsion having a very pronounced solarization is chosen. The emulsion is brought up to the point M where the part S of the solarization begins, not by a preliminary exposure but by a special kind of emulsion ripening that takes place in the presence of substances which cause fog. For instance, with the addition of silver

TABLE I

Some Data on Direct Duplicating Film with Various Developers

DEVELOPER	DEVELOPMENT TIME	DENSITY		GAMMA	LATITUDE 2^n n
		Maximum	Minimum		
	minutes				
Direct Duplicating	4	1.9	0.06	−1.5	
	6	2.5	0.08	−2.3	6
	8	2.7	0.10	−2.7	
X-ray	$3\frac{1}{2}$	2.2	0.08	−2.0	
	5	2.6	0.10	−2.5	6
	8	2.7	0.12	−3.0	
Glycin	8	1.8	0.12	−1.3	
	12	2.4	0.15	−1.7	6.5
	20	2.7	0.25 Y	−2.2	
Borax fine-grain	8	1.1	0.10	−0.6	
	12	1.6	0.12	−0.8	7.5
	20	2.0	0.18	−1.1	
Amidol	4	1.5	0.15	−1.3	
	6	2.2	0.20	−1.7	6.5
	10	2.4	0.25 Y	−2.0	

nitrate, photographic ripening substances or developing agents such as hydroquinone, the emulsion is treated at a high temperature for a certain length of time. Later the surplus of the fog producing agents is washed out. Not all emulsions give the same good results, but it can be said that all emulsions which show a suitable solarization show at least a good solarization curve when ripened in the presence of fog causing agents.

Of course, to achieve this result the original emulsion must show a pronounced solarization and the most favorable conditions for the special ripening process must be determined experimentally. The range of densities of the emulsion which is used in making the Direct Duplicating

TABLE II

Developers Listed in Table I

DEVELOPER	COMPOSITION		
Direct Duplicating	Metol	5	grams
	Sodium sulfite (anhydrous)	35	grams
	Hydroquinone	3	grams
	Sodium carbonate (mono)	30	grams
	Potassium bromide	1	gram
	Water	1000	cc.
(To be diluted with 1 part of water; development time, 6 minutes at 65°)			
X-ray	A metol-hydroquinone-sodium carbonate developer with:		
	Metol	3.5	grams
	Hydroquinone	9.0	grams
	Water	1000	cc.
Glycin	Glycin	50	grams
	Sodium sulfite (anhydrous)	125	grams
	Potassium carbonate	250	grams
	Water	5000	cc.
Borax fine-grain	Metol	1.5	grams
	Sodium sulfite (anhydrous)	80.0	grams
	Hydroquinone	3.0	grams
	Borax	3.0	grams
	Potassium bromide	0.5	grams
	Water	1000	cc.
Amidol	Amidol	20	grams
	Sodium sulfite (anhydrous)	100	grams
	Water	5000	cc.

film is more than 2.0 under suitable development, with a maximum density of about 2.5 and a minimum density (fog) of 0.1. The range of exposure covered by this curve is ample to give photographically valuable results.

Direct Duplicating film has great promise of wide application in the medical field, particularly with regard to X-ray film, where it may be used for direct contact prints, camera reductions, lantern slide purposes and for photomicrographs. This film will enable the roentgenologist to accumulate a wealth of pathological data for museum purposes at a minimum expense. The older two-step method of making duplicates necessitated the use of two films with resulting loss in time, material,

FIG. 9

FIG. 10

FIG. 9. Influence of methylene blue treatment. *B:* Film immersed in solution of 0.01 per cent methylene blue in water, and developed in x-ray developer. *A:* Film not treated with methylene blue solution.

FIG. 10. Two films exposed for the same time under the same x-ray negative. *Left:* Film developed in Direct Duplicating developer and then fixed, resulting in a duplicate. *Right:* Film, after same exposure, fixed and then developed in a physical developer, resulting in a negative.

detail and other photographic qualities. Direct Duplicating film, when properly used, permits the duplication of radiographs.

Radiographs may be duplicated in their original size by using an ordinary contact printing frame. A standardized and reliable light source is of the utmost importance in procuring best results. One which may be used for both contact and reduction printing is the conventional 14 x 17 X-ray film illuminator which contains a special 200 watt x-ray bulb. This provides an evenly diffused light which is satisfactory for

illuminating an original for reduction printing or for exposure at a distance of 6″ in contact printing. The average exposure for contact duplicates with the printing frame 6″ from the open glass of the light source mentioned above will vary from about 4 seconds for thin radiographs to approximately 8 seconds with x-ray originals of heavier density.

Reduction duplicates, too, can be made with simplicity by using Direct Duplicating film in a clinical camera to photograph the original radiograph. The original is in this case placed in front of the same light

Courtesy Jour. Soc. Mot. Pic. Eng.

FIG. 11. Direct Duplicating film in miniature photography. *Left:* Unretouched enlargement. *Right:* Enlarged positive obtained from enlarged partially retouched negative made in a single step with Direct Duplicating film.

source used for contact printing, and the exposure at f: 4.5 is about 60 times that required for contact printing. Converting the exposure time required for contact printing from seconds to minutes with the lens at f: 4.5 serves as a satisfactory exposure guide. The exposure time for making reduction duplicates may be materially decreased by using an illuminator equipped with one or more photoflood bulbs. The lantern slides previously mentioned were made on Direct Duplicating film mounted between thin lantern slide cover glasses and bound with passepartout. Figures 9 and 10 show lantern slide reductions of a pelvis and a lateral lumbar spine radiograph.

Direct Duplicating film may also be used advantageously for making enlarged negatives from miniature negatives for retouching purposes. The miniature negative is placed in the enlarger with the emulsion side facing the lamp. It is enlarged on the Direct Duplicating film, the emulsion side of the latter facing the miniature negative. In this way the relative positions of the left and right sides are reproduced as in the original. The photographic characteristics of the Direct Duplicating film are flexible enough in the gradation to give a satisfactory, enlarged negative and from this a satisfactory, enlarged print. Figure 11 shows

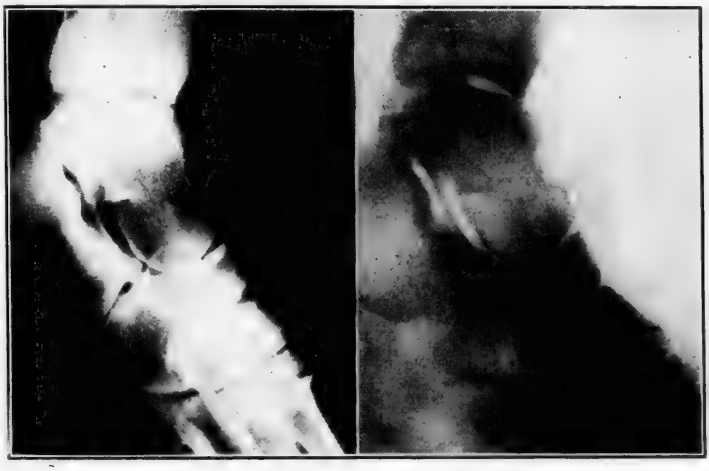

FIG. 12 FIG. 13

Two films exposed for the same time under the same x-ray negative.

Fig. 12 shows film developed in direct duplicating developer and then fixed, resulting in a duplicate.

Fig. 13. Film after same exposure, fixed and then developed in a physical developer, resulting in a negative.

one print made directly from a miniature original and compared with another print made from an enlarged negative on Direct Duplicating film. Note where the film has been retouched.

From the foregoing it is quite obvious that Direct Duplicating film has great possibility and promise and should find a definite place and many uses in the medical photographic laboratory.

Summary: Duplicates of positives or negatives can be made by the familiar process of exposure, standard development and fixation of a

single film without requiring second exposure and development, as in the case of amateur motion picture reversible film, or by resorting to the duplicate negative process. Contact printing is required with exposures equal to those used in printing chloride photographic paper emulsions. The emulsion, although of silver bromide composition, is of a type entirely different from all other photographic emulsions, making use of the solarization effect for the first time in practical photography. Some commercial possibilities of the new type of emulsion are seen in the duplication of X-ray and other valuable transparency originals, aerial mapping, motion picture still picture printing, photo reproduction practice and general commercial photography.

PHOTOGRAPHY OF THE CAPILLARIES IN THE CUTICLE OF THE FINGERNAIL*†

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London, England

The capillaries to be photographed are situated in the cuticle of the nail just at the point of junction of the live skin with the dead skin and, as will be seen from the photographs in figure 2, they consist of minute loops. Their formation is of particular interest in the case of rheumatic subjects. This work of photographing the capillaries was undertaken in connection with a study of rheumatism made by Dr. Kersley of Bath.

At first the ordinary horizontal camera and microscope were tried, but with little success. It was found to suffer from the two following disadvantages:

1. The difficulty of maintaining the hand steady in this position.
2. The subject could not be focused and kept under observation right up to the time of exposure with sufficient ease.

The vertical position was therefore adopted. The use of an eyepiece camera, together with a demonstration ocular, overcame the difficulty of focusing.

Some trouble was at first encountered in obtaining sufficient illumination to allow exposures short enough to eliminate movement on the part of the subject. Finally a 20 ampere, 3 pole horizontal arc was adopted

* From the Research Laboratory, Ilford Limited.

† Received for publication September 15, 1936.

in which there are two negative carbons and one positive carbon at angles of 120° to each other. By this arrangement the path of the light from the crater of the positive carbon is unobscured by the negative carbons, and a tolerably constant orientation of the crater is ensured. A diagram of the arrangement of the apparatus is seen in figure 1.

The beam, rendered slightly convergent by the condenser, passes through two glass cells, each 6 inches deep, containing water slightly tinged with copper sulphate (about 1:500) to absorb the heat. From these cooling cells the beam passes through a gelatin color filter. It then impinges upon the concave surface of the microscope mirror, which is removed from the instrument and suitably held in position by means of a clamping device. The light is thus brought to a focus upon the cuticle of the finger which is being photographed. The mirror is about 2 to 3

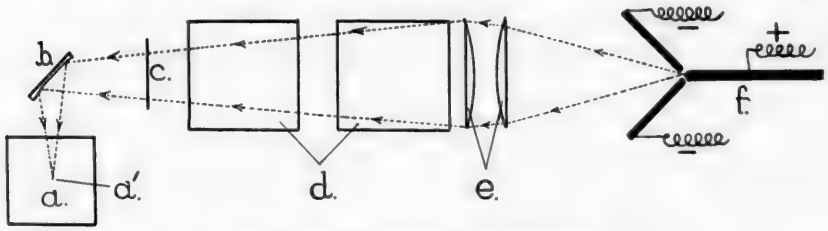

FIG. 1. PLAN DIAGRAM OF APPARATUS

a, stage of microscope; *a′*, position of the cuticle; *b*, microscope mirror; *c*, gelatin color filter; *d*, glass cooling cells; *e*, condensing system; *f*, 3 pole arc light.

inches higher than the stage of the microscope and inclined so as to direct the beams downward, thus giving an angle of approximately 45°. If the triple nosepiece is at all large it may partially obstruct the beam and should be removed.

A black finger rest consisting of a plywood base with narrow parallel slats about an inch apart is placed flat upon the stage, the elbow of the arm being supported on a rest placed upon the bench.

Before the exposure was made, cedarwood immersion oil was well rubbed into the cuticle under examination and an additional layer of the oil was spread on the surface. Without this treatment only the surface texture of the skin could be seen, the capillaries being completely invisible.

As the contrast in this type of subject is low an emulsion accentuating the color and tone is necessary. For this purpose Ilford Process Pan-

chromatic plates were used in conjunction with the Ilford H. W. filter No. 403 (light bluish-green). The development was for 2 minutes at 65°F. in hydroquinone caustic developer (I.D.-13). This gave adequate contrast for printing on a normal bromide paper. The exposure required was 1/10th to 1/25th second. It was necessary to watch the movements of the subject and to release the shutter when these were at a minimum.

Exposures also were made on Dufaycolor flat film with fair success, but the contrast was not sufficient to obtain as much differentiation between the capillaries and the background as is desirable. However. a color technique can be developed for this type of subject.

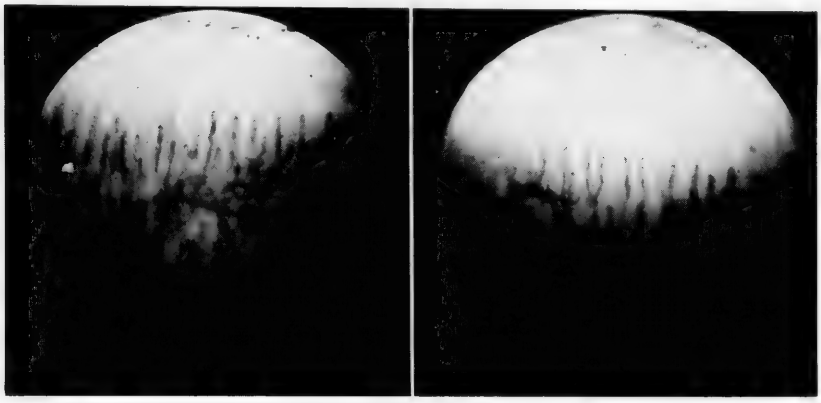

FIG. 2. PHOTOMICROGRAPHS OF CAPILLARIES IN NAIL BED FOCUSED FOR TRANSVERSE AND HORIZONTAL CAPILLARIES. × 26

Editors note: In connection with this subject the following articles should prove of considerable value:

1. Rosenberger, A.: Micro-Cinema in Medical Research. Trans. Society of Mot. Pic. Eng. Vol. XI, No. 32, 1927, pp. 750–758.
2. Heard, O. H.: Some Practical Considerations on Time Lapse Motion Photo micrographic Devices. Jour. Bio. Photo. Asso. Vol. I, No. 1, 1932, pp. 4–18.
3. Proetz, Arthur H.: Studies of Nasal Cilia in the Living Mammal. Annals of Otology, Rhinology and Laryngology, Vol. XLII, No. 3, 1933, pp. 778–788.

In the above mentioned articles will also be found forty-seven additional references to articles on the same or allied subjects.

SUMMARY OF TALK PRESENTED BEFORE THE MEETING OF THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION AT BOSTON, MASS. SEPTEMBER 24–26, 1936*†

BRUCE MAYNE

The United States Public Health Service is represented in its field investigations of malaria as being interested during the past nine years in producing motion picture film depicting the life story of the malaria parasite in man and the mosquito. Research work on this subject had been inaugurated even before the time that the Viennese physician, Wagner Von Jauregg, the Nobel Laureate, made his discovery that fever produced by the malaria parasite has a beneficial action upon brain cells of persons afflicted with general paralysis of the insane. It had been demonstrated before this time, 1915, that mosquitoes could be used to infect people and be maintained in a state of infectivity for periods up to two months. Keeping abreast of the times in medical progress, the use of malaria was recognized as an ameliorating factor in the treatment of victims of softening of the brain and was carried on in various Government hospitals under the supervision of the United States Public Health Service.

Recently it has been found practical to use live mosquitoes, which have been reared and maintained in a special insectary, for the induction of malaria in patients requiring the benefits of this type of therapy. The first mosquitoes were shipped in special containers to various hospitals for this special application. It was then found too costly to maintain this procedure on a large scale, and the growing demands from nearly every hospital for mental diseases in the United States made it imperative to devise some more economical method. Subsequently it was found that the shipment of infected materials made up in a culture tube from the mosquitoes' organs could be satisfactorily applied on a practical basis. It was shown that shipments of this material could be made to the remotest mental hospital in the United States. This practical demonstration proved that the salivary gland organisms of the mosquitoes would survive ordinary mailing shipments for a period of more than six days, also that the organisms could be kept alive *in vitro* for as long a period as twenty-six days and still reproduce the disease upon injection of the patient requiring malaria therapy.

* From the U. S. Public Health Service.

† Received for publication October 22, 1936.

The illustrated lecture given at the Sixth Annual Convention of the Biological Photographic Association on the Parasitology of Malaria in Man and the Mosquito was presented in 16 millimeter film reduced from the original 35 millimeter. It showed every phase of the process of preparing the malaria organisms from infected mosquitoes after they had bitten the patients who had previously been subjected to the same type of treatment. The actual picture of the malaria parasite entering the human blood corpuscle was presented for the first time in the history of malaria illustrations. The complete development of the course of the life history in the blood of man followed by the continuation of this development outside of the body of man and in the mosquito was illustrated by actual photography in most of the phases. The picture was completed with a showing of an actual scene in a hospital ward, with a medical officer in the act of administering an intravenous injection of mosquito malaria parasites to a patient suffering from softening of the brain.

THE RADIOGRAPHY OF SMALL BIOLOGICAL SPECIMENS*†

H. F. SHERWOOD

Rochester, N. Y.

The purpose of radiography in its ordinary medical and industrial applications is the investigation of gross structures. The image of the area of interest is fairly large and the radiograph may be viewed with the naked eye. Many biological specimens, however, are very small and, in order to render their finer structural details, it is necessary to use an appropriate technic and to enlarge the image for viewing.

It is not possible to focus X-rays with any sort of lens and thereby construct an "X-ray microscope" to enable structures too fine to be seen by the naked eye to be examined with X-rays. The only practicable procedure, therefore, in the examination of small objects is to radiograph the specimen upon a fine-grained plate or film, and either examine the radiograph with a lens or enlarge it photographically to an extent that will enable the details to be seen comfortably by the unaided eye. This method has been used by Goby (2), Fricke (1), Bucky (6), and others in the examination of small biological specimens. With

* From The Kodak Research Laboratories, Eastman Kodak Company.

† Received for publication Dec. 12, 1936.

the use of specially prepared fine-grained plates, Goby found that satisfactory enlargements up to 75 diameters could be obtained.

There are many types of small biological specimens, however, with which enlargements of 5 or 10 diameters would be very useful. With the equipment and materials which are now readily available, the method of radiographing them is simple and offers many advantages in the studies made both for research and for teaching purposes. It is the object of this paper to describe the procedure and to illustrate the character of the results which may now be obtained.

In the first place, long wave length X-rays known as soft X-rays or "Grenz rays" must be used. These rays have the low penetrating power best suited for the production of good radiographs of small biological specimens such as insects, plant structures (flowers, stems, or leaves), etc. A special form of X-ray tube is required to produce these rays and it must be fitted with an extremely thin window to permit their escape. The voltages applied to the tube range from 4 to 15 kilovolts, which is quite low compared to those used in medical radiography and in radiography of industrial materials.

As in other types of radiography the specimen is mounted in close proximity to the film or plate, the tube is placed at a suitable anode-film distance, and the X-rays pass through the specimen and cast a shadow image on the emulsion. The film or plate must be mounted in a holder that will protect it from ordinary light but permit the X-rays to pass through.

An infra-red gelatin filter (Wratten No. 87) has been found to best serve the purpose of protection; it is homogeneous in texture and is opaque to the light to which the plate or film is sensitive. Thin black paper affords an effective protection for the photographic material, but its use is impractical in this work because its structure is recorded by the X-rays. In handling the filter care must be exercised to avoid scratches, moisture, finger prints or other marks that may be registered in the radiograph.

The plate or film holder is so devised that the specimen may be mounted either in contact with the plate or film, or on the gelatin filter when it is placed on the recording medium. The holder shown in Figure 1 was made from a lantern plate box by cutting an opening in the top and covering it with a No. 87 gelatin filter. This box can be loaded conveniently in the processing room and then brought out into the light for the radiographic exposure.

Figure 2 shows a roll film holder especially designed for soft X-ray

radiography. The protective gelatin filter (Wratten No. 87) is mounted in the holder directly over the exposure area of the film. The full area available for a single exposure is $2\frac{1}{4}$ by $3\frac{1}{4}$ inches, or one-half of this area, or $1\frac{5}{8}$ by $2\frac{1}{4}$ inches, may be used by inserting a brass slide to cover the other half of the exposing window.

In order to obtain a suitable degree of enlargement a fine-grained plate or film must be used. Slow lantern plates and a specially pre-

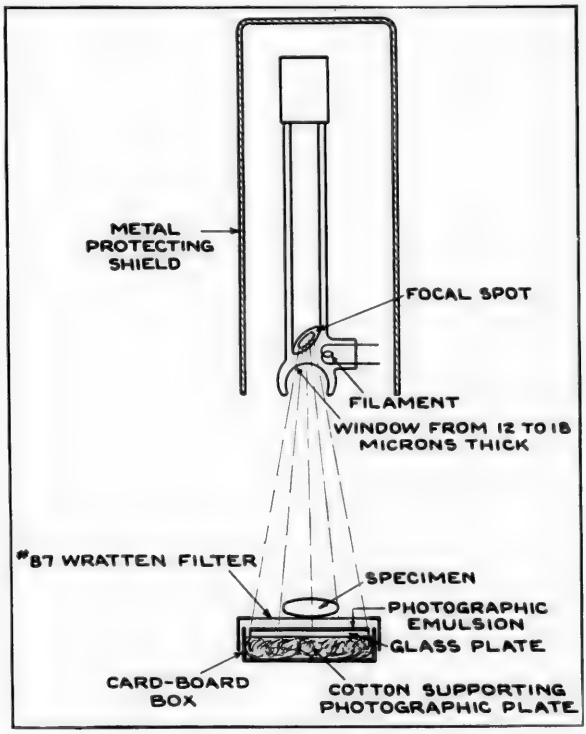

FIG. 1. DIAGRAM OF APPARATUS FOR SOFT X-RAY RADIOGRAPHY

pared film for soft X-rays have been found the most satisfactory materials provided enlargements not greater than twenty times are required. If greater enlargement is desired, a finer grained but slower emulsion must be made especially for the purpose.

The sharpness of detail depends somewhat on the size of the focal spot of the X-ray tube, particularly for the thicker specimens. The illustrations shown in this article were made with a focal spot about 4 mm. in diameter.

The range of exposure conditions is indicated by the following table:

Tube voltage	4–15 Kilovolts peak
Milliamperes	2–8
Anode-film distance	4–15 inches
Time	3–30 seconds

The choice of tube voltage is governed largely by the thickness of the specimen; the higher voltages are generally the best for the greater thicknesses. A thin specimen such as the wings of the moth, Figure 3,

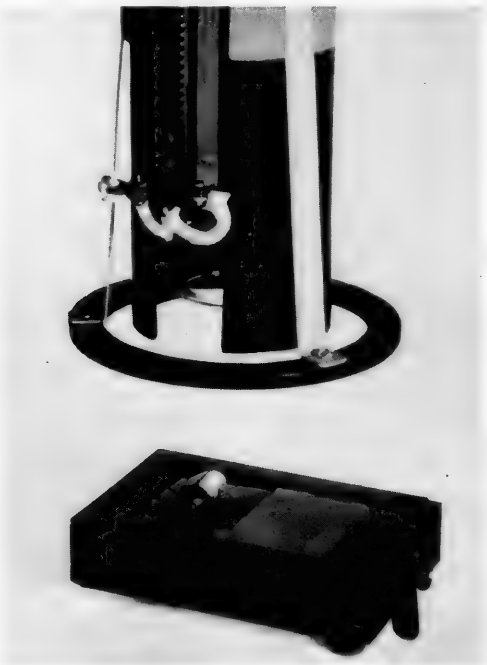

FIG. 2. ROLL FILM HOLDER

requires a very low tube voltage to secure adequate contrast in the radiograph.

Stereoscopic radiographs may be made in the usual way. The specimen is supported separately from the plate or film box, so that one plate can be removed and another put in its place without disturbing the specimen. With the first plate or film in position, the X-ray tube is shifted about 5 degrees from the vertical axis and the first exposure is made. The exposed plate or film is then replaced by another; the tube is shifted to a position 5 degrees on the other side of the vertical axis

FIG. 3. POLYPHEMUS MOTH

Left-eye View Right-eye View

FIG. 4. STEREORADIOGRAPH OF PASSALUS CORNUTUS

(a total shift of 10 degrees) and the second exposure made. The enlargements may be viewed properly in any hand stereoscope; they give a vivid impression of spatial relationships and the arrangement of the parts within the specimen.

As a rule, the stereoscopic shift of the X-ray tube should be at right angles to the long dimension of the specimen or to the principal structure lines in the specimen. The radiographs should be viewed in such a way that the direction of the shift with respect to the radiographs is

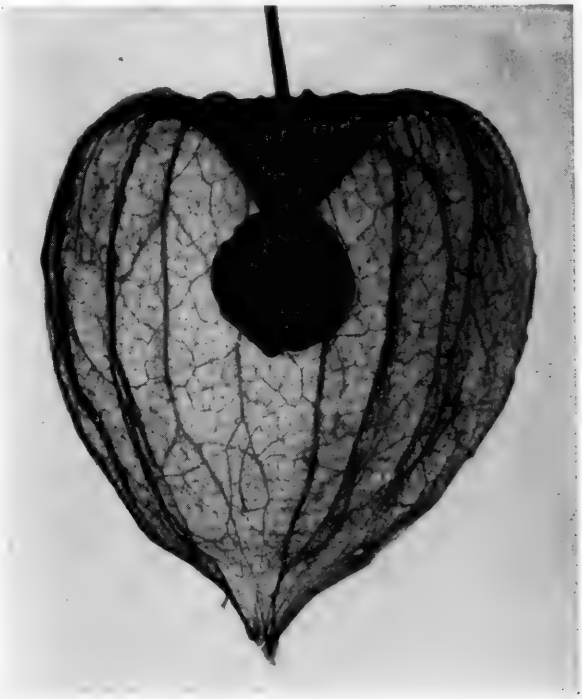

FIG. 5. PHYSALIS FRANCHETTI (JAPANESE LANTERN)

parallel to a line connecting the pupils of the eyes of the observer. The right eye views the radiograph made in the right-hand position of the tube, and the left eye the radiograph made in the left-hand tube position, Figure 4.

In the stereoscopic exposure procedure, the specimen and plate together may be tilted through an angle of 10 degrees instead of shifting the X-ray tube between the two exposures. A convenient mounting for tilting the specimen and plate has been devised by Goby (2).

Since the specimens must be stationary during the exposure, insects must be either dead or anesthetized.

Insects which are transparent to infra-red rays can be photographed by infra-red light to show their internal structure. All insects, however, are transparent to X-rays, so that the X-ray method has a much wider application than infra-red rays in this class of work.

In the main, the accompanying illustrations speak for themselves. Unquestionably the radiographic study of such specimens should prove useful for many research and educational purposes. The radiographic method should be a valuable adjunct to dissection. It should

FIG. 6

FIG. 7

FIG. 6. CUCUJUS FLAVIPES FABR

FIG. 7. FEMALE COCKROACH (BLABERUS CRANIIFER) CARRYING EGGS

also provide a convenient method for studying the variations in insects of the same species, and changes in one particular insect during its cycle of development and growth. Those engaged in the biological sciences will undoubtedly recognize suitable applications of the radiographic procedure in their individual fields. There is reason to believe that the radiographic method will prove relatively as useful in the basic biological sciences as it has in medicine and industry.

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(6) BUCKY, G.: Grenz Ray Therapy. The MacMillan Company. New York.

PRINT CRITICISM

S. J. McCOMB

Diagnostic skin tests frequently present problems in lighting and film choice for the clinical photographer. In the case illustrated the patient had a wheal surrounded by an area of redness, on the upper arm. The problem was to reproduce accurately the diffuse red area, and to show to what extent the wheal was elevated.

FIG. 1

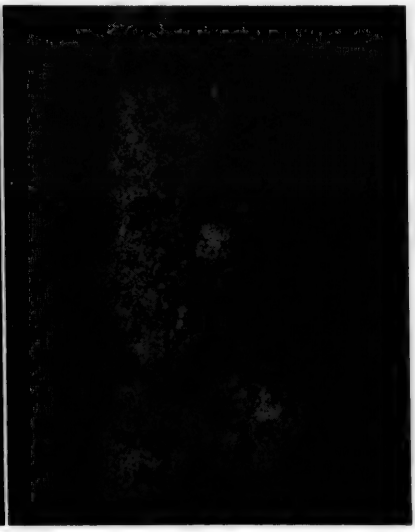


FIG. 2

The photograph in Fig. 1 was exposed on Par Speed Portrait film for one second at f: 16, no filter, with a broad general lighting. It fails completely to show either of the conditions described.

The photograph in Fig. 2 was exposed through a "B" filter on Commercial Pan film for three seconds at f: 16, which shows very well the reddened area. The same general lighting was employed, with the addition of a spot light on the left and a little above, which created a highlight on the left side, and a shadow on the right side, of the wheal, indicating the degree of elevation.

PHOTOGRAPHIC TECHNIC, NEW PROCESSES AND EQUIPMENT*†

F. R. HARDING

Boston, Mass.

A PHOTOGRAPHIC AID TO PLASTIC SURGERY

The following method of etching, scaling, and double printing has been employed on patients requiring some forms of plastic surgery. It has been of considerable assistance to the surgeon and undoubtedly has applications other than the one to be described.

The case illustrated had a large section missing from the left ear. A close-up view of the affected left ear was made; also a view of the right ear, employing exactly the same focus. After the negatives were dried, a thin line was etched around the inner margin of the affected ear (Fig. 1A). A line was also etched on the outer margin of the unaffected ear (Fig. 1B). The etched area should exactly coincide with the area marked on "A" negative. This may be determined by reversing "B" negative, placing it over "A" so that the emulsion surfaces of the two negatives are in contact with each other. Superimpose the two ears and mark the points where the etched line of "A" touches the outer margin of the ear in "B." This mark may be a tiny nick made with the etching knife. The marks will be on the back or shiny side of "B." Turn "B" negative with the emulsion side up and connect the two nicks by etching along the outer margin of the ear. Reverse "B" and again superimpose the two negatives, taking care that "A" negative is on the bottom, otherwise the resulting print will appear to be a right instead of a left ear. With the two negatives in position on the printer it will be seen that the etched lines show the area to be filled in by the graft. As a further guide a crosslined screen[1] may be inserted *between* "A" and "B" negatives. A print made with this combination will show the area to be filled in and also offer a scale by which the total flat surface to be filled in may be figured.

The limitation of this method appears to be that thickness is not shown. It might be possible by stereoscopic photography to offset

* From the Department of Photography, Children's Hospital.

† Received for publication Jan. 16, 1937.

[1] "The Invisible Photographic Screen," F. R. Harding. Jour. Biol. Photo. Assn. Vol. 1, No. 4.

this disadvantage. The writer would be pleased to hear from anyone who tries the method.

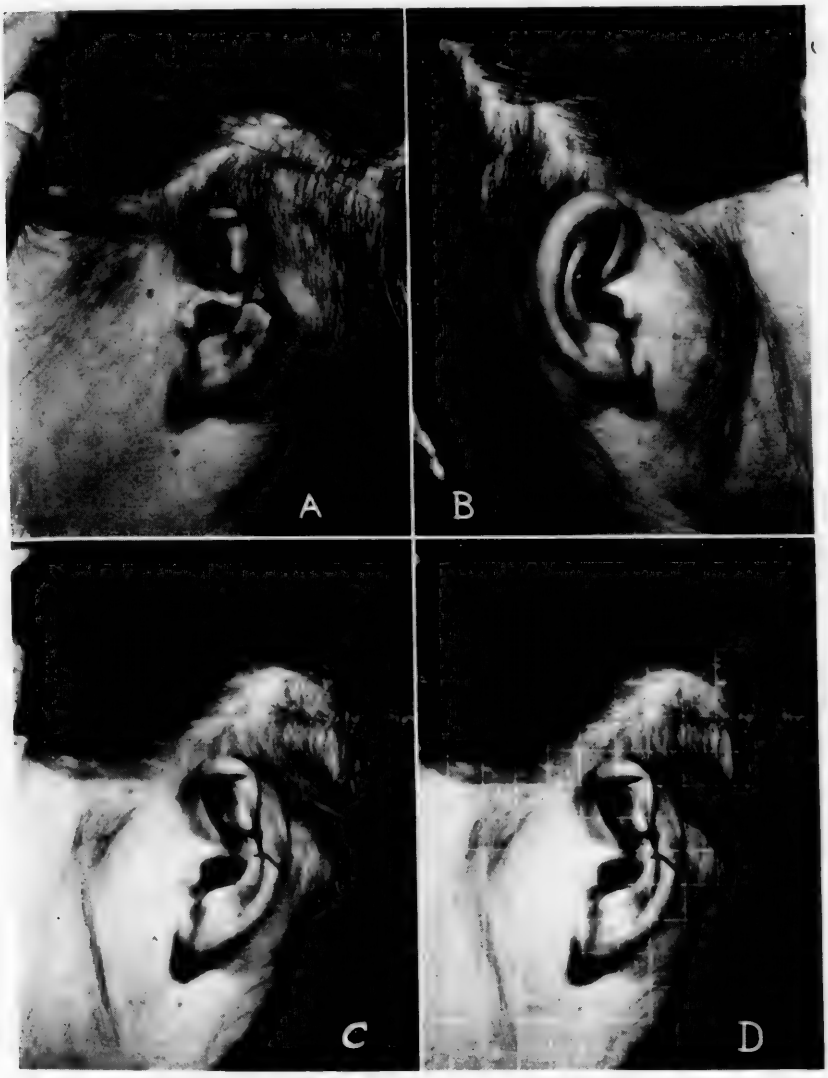


FIG. 1. "A," affected ear. "B," unaffected ear. "C," "A" and "B" combined. "D," "A" and "B" with screen.

A NEW MOTION PICTURE LABORATORY HANDBOOK

A new Eastman publication, "Motion picture laboratory practice and characteristics of Eastman motion picture film," is off the press. It is addressed to all those

interested in the use and processing of 35 mm. motion picture film, especially the small commerical laboratory or the large producing unit. It is an authoritative handbook of information on the characteristics of present-day Eastman films, the laboratory handling of film and related subjects. Among the latter are the uses of color filters and polarizing screens, topics of prime interest in today's motion picture practice. The book has been published in response to a number of requests for such a work and will find ready acceptance in the industry.

THE CORRECT USE OF SAFELIGHTS

The importance of safelighting in the darkroom hardly needs to be emphasized. Yet photographers very often, through misunderstanding or carelessness, use an improper safelight or a lamp of too high wattage, with a consequent fogging of materials. Quite often the fogging is not enough to be readily noticed but it may be sufficient to materially affect the quality of the negative or print.

A safelight must fulfill two requirements. In the first place, it should filter out all light to which the material being used is most sensitive. Secondly, it should provide as much working illumination as is consistent with safety. No one safelight can meet these requirements for all materials. The photographer must know which safelight to use with the material he is using.

There are three series of Wratten safelights for use with negative materials. Series 1 is an orange-green safelight for use with all films and plates which are not sensitive to green or red. Series 2, a deep red safelight, should be used with all orthochromatic films and plates, these materials being sensitive to green but not to red. Series 3 is a green safelight for use with panchromatic films and plates. Since panchromatic materials are sensitive to all the visible colors, this green light is quite faint but gives sufficient illumination as the eyes become accustomed to it.

Another series of Wratten safelights is available for use with photographic papers. Series OO is a clear yellow safelight for use with Velox, Azo, Ad-Type, Athena and other chloride papers. Series O, a bright orange, is used with Opal, Projection, PMC, News and all other bromide papers, as well as with lantern slide plates. Series OA, a greenish-yellow safelight, is used with the same materials as Series O but gives a better light for judging prints. The Wratten safelight Series 2 must be used with Insurance Bromide, as this paper is highly sensitive to green.

Wratten safelights are accurately adjusted in the spectroscope and by trial with a definite standard of safety in mind. It must be understood, however, that no light can be made which is really safe if a film or a plate is exposed to it for too long a time.

When used with the proper bulb and at the recommended distance, three feet from the sensitive material, Wratten safelights are safe for one-half minute. This time is considered ample for ordinary handling of dry materials. When wet, films, plates and papers are less sensitive to light.

If safelight lamps are placed at less than three feet or if bulbs used are of higher wattage than those recommended, the standard of safety is decreased and tests will be necessary to determine just how long material can be safely exposed to such a light.

To make the test place a strip of sensitive film, plate or paper on the bench where such material would normally be handled. Expose several areas on the strip to the safelight for different periods, ranging from 30 seconds to 5 minutes, by covering the strip with cardboard and moving it after each increment of exposure. An unexposed

area should be left at one end. Develop in a clean working developer, rinse, fix and dry. The first area which shows a density greater than that of the unexposed portion indicates the time that is unsafe for the material tested.

In addition to making this test from time to time the photographer should inspect his safelights frequently. Accumulated dust should be removed and the glass examined for cracks and discoloration. Aim to have the greatest possible amount of safelight for comfort and convenience, but observe the necessary precautions to be sure it is safe.

RAPID METHOD OF DETERMINING ENLARGING AND REDUCING PROPORTIONS*

R. B. HARDING

West Newton, Mass.

Enlarging or reducing a rectangle or square is virtually the same as stretching or shrinking it diagonally. Figure 1A shows how a 4 x 5 print may be enlarged or reduced proportionately by employing a diagonal line. By this simple method it is possible to determine the exact size of both dimensions in either enlarging or reducing from negatives of any size.

The apparatus consists of two "L" shaped strips of cardboard marked in inches and a sheet of cardboard slightly larger than the greatest enlargement usually made. This cardboard is ruled in one inch squares. Note that the two "L" pieces must be cut accurately to a right angle with the aid of a carpenter's steel square or some other accurate tool. For convenient handling, one of these "L" pieces is attached to the sheet with gummed paper. See Figure 1B. Note that this "L" is cut diagonally at angle X. This permits a hole to be pierced exactly at the intersection of the angle lines. A stout thread is drawn through the hole and knotted to prevent the thread from pulling out. The other end is attached to the spur of a push pin. This thread is employed as a diagonal on any rectangle or square.

Figure 1B indicates a portion of a picture, either a print or a negative, masked to 4 x 5 with the two "L" pieces and the thread pinned to that diagonal. By reading in from the edges or sliding "B" diagonally along the thread, all sizes proportionate to 4 x 5 will be shown. Thus

* Received for publication January 16, 1937.

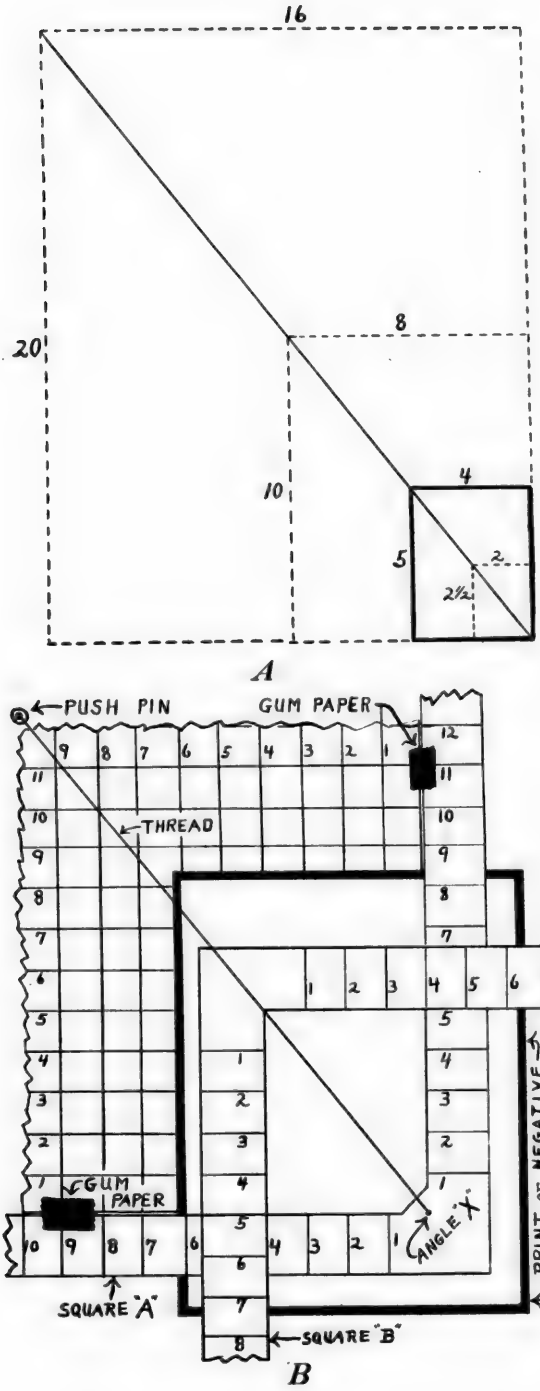

16
20
8
10
4
5
2
2½
A
PUSH PIN
GUM PAPER
THREAD
GUM PAPER
ANGLE "X"
PRINT or NEGATIVE
SQUARE "A"
SQUARE "B"
B

FIG. 1

it can be readily determined whether a given rectangle will enlarge to fit an existing frame and, conversely, the size frame required to fit an enlarged rectangle.

This method is useful when several pictures are to be enlarged or reduced for a layout, as the pictures may be composed in advance to fit the space or the layout altered to fit the final prints.

This method has several other uses, one of which is to employ it on a negative in deciding which portions of the negative are to be used and then, by sliding the movable "L" along the diagonal thread, the exact dimensions of any enlargement may be read.

Association News

The next meeting of the Biological Photographic Association will be held in Rochester, N. Y., September, 1937. The following committee has been appointed to arrange the program:

William F. Payne, *Chairman*,
Arthur W. Fuchs,
Stella Zimmer,
L. V. Foster.

Those contemplating the presentation of papers should address Mr. Payne at the State Institute for Malignant Disease, Buffalo, N. Y.

Color photography will be the dominant theme of the program although our members are urged to present short papers of the "how-to-do-it" variety. Methods that achieve short cuts or provide a means of improving existing methods are satisfactory. However, papers of definite scientific interest or those describing original work will be most welcome. Please drop a note to Mr. Payne and tell him about the work you are now doing and whether you can prepare a paper for the next meeting.

* * * *

The New York Chapter met January 14 in the Poloroid Theatre in the New York Museum of Science and Industry. A complete demonstration of Poloroid materials with special reference to their application to photography and optics, was made by Mr. Wheelwright of the Land-Wheelwright Corporation. In addition to the stereoscopic motion pictures of general interest, there was also a surgical film. Some of these pictures were made by the newest methods in which two pictures are projected side by side from *the same film*. The pictures shown at our convention in Boston were made by two synchronized cameras at eye distance apart. These films then required two projectors which superimposed the images on the screen.

This Chapter has had some excellent programs by outstanding craftsmen who showed their work and described their methods. The Program Committee has at last secured Squibb Hall, 745 Fifth Avenue, New York City, for meetings on February 26, April 23 and May 28. At the February meeting, Mr. Louis Schmidt presented a paper on photomacrography—photography by low magnification under 50 diameters; there was also a presentation regarding the Wonderlite Filter Flood Lamps. At the April meeting, Mr. Harold A. Dumont of the Defender Photo Supply Company, will describe their line of sensitive materials with special reference to the Tri-pac and Chromatone products for color photography.

* * * *

The November, 1935, meeting of the Boston Chapter was held in the Biological Laboratories of Harvard University, with Professor Brues officiating. A large and

varied collection of both black-and-white and color plates of biological subjects was on display. Two of the exhibits were of exceptional merit: a group of photographs of orchids and a series of color plates showing the color variation of the human iris from pale blue to dark brown.

The December meeting took place in Mr. F. R. Harding's Department of Photography, Children's Hospital. Apparatus was demonstrated for the making of reduced copies of radiographs. Mr. Robert Waldman of the Eastman Kodak Stores, Inc., Boston, spoke. The subject was "Surgical Motion Pictures." Mr. Harding's special display of clinical photographs have been placed in the Hospital Library where students and doctors may view them at their leisure.

The January meeting convened at Boston Police Headquarters, Division of Photography. Mr. Francis Sullivan was the host. Infra-red and other examples of police photography were shown. A tour of the laboratory took place which included the Bureau of Records and Communications Department.

All of the above meetings were well attended.

* * * *

The Pittsburgh Chapter of the Association met on January 6. It began with a short business meeting on a very welcome subject—"How to Spend a Hundred Dollars." A gift amounting to that sum has been made to the Chapter by Miss Isabelle Chalfant of Pittsburgh. Various plans were discussed in open meeting, for instance, the formation of a library of photographic books available to members; the purchase of exhibition equipment to be used for showing work at the Chapter's meetings, and available to members for exhibit purposes at their own scientific meetings; the financing of special lectures. The members voted not to limit the use of the money to any one plan at present, but to leave the matter in the hands of the executive committee for further consideration. The business meeting was followed by the presentation of two papers: "Photographs for Publication" by Mr. J. Shewe of the B. K. Elliot Company, and "Photographic Lenses" by Mr. Chester O. Henry of the Falk Clinic, Pittsburgh.

* * * *

We hear that Dr. Oscar W. Richards is leaving the Osborn Zoological Laboratory at Yale University to become biologist in the newly formed Scientific Department of Spencer Lens Company, Buffalo, N. Y. We wish him every success in his new connection.

* * * *

Mr. Arthur A. Hebert, Jr., 55 Allyn Street, Hartford, Connecticut, attended the Boston Convention with camera-and-flashlight apparatus complete! The results of this preparedness are now in print form, and candid is the word for them! Mr. Hebert will send these prints to applicants, postpaid, for ten cents per print. In case you want to know who is implicated: there are three group pictures of members who (we do not know exactly how) happen to be in the Hotel Lenox bar. One shows Mr. Zieler delivering a discourse to Mr. Walcott; Miss Shiras (as she hopes and swears she never looked in her life); Mrs. Kingsbury in a moment of hilarity; Mr. Schmidt, his badge waving in the breeze; and one eye and the nose of Miss Melvin. There is another group picture in which Mr. Walcott is the foreground, and Miss Zimmer, Mr.

Kieffer, and Mr. Brooks blowing a fine cloud of smoke, are the background. The most inclusive of the three gives us Mr. Julin, Miss Zimmer, Mr. Fuchs, Miss Shiras, Mr. Jessup, Mrs. Kingsbury toasting the photographer, Miss Melvin, Mr. Clarke, Mr. Creer and the back of Mr. Walcott's head. Of two close-up studies, one involves Mrs. Kingsbury and Miss Zieler; the other, Miss Shiras, Miss Melvin and Mr. Jessup. These were not taken in the bar, but later, when Messrs. Kieffer and Grallo were holding open-house.

* * * *

Members of the Association of course are always welcome to contribute worthwhile articles to the *Editor*. The following list of subject matter can serve as a guide:

Descriptions of apparatus constructed to satisfy specific needs.

Working directions for making all kinds of photographs.

Biological subject matter having photography as its means of recognition.

Low-power photomicrography.

Title-making.

Infra-red and ultra-violet photography.

Ingenious dodges that make photographic work easier and more efficient.

Remember that generally speaking the length of an article does not always signify its worth—neither does the length of its bibliography!

* * * *

Doctor Edgerton's high speed motion pictures were shown in Pittsburgh, January 27, at a combination meeting of the Pittsburgh Chapter of the B. P. A. and the Audubon Society of Western Pennsylvania. These films were obtained by writing Professor Charles Locke, Alumnus Secretary, Massachusetts Institute of Technology, who is lending 16 mm. reels for this showing. The films are highly recommended for local chapter meetings—they open a new world in the photography of motion.

* * * *

Mr. Jean Kieffer recently gave lectures before the Medical Society of Westerley, R. I.; The Parent-Teachers Association of Gales Ferry, Conn.; and, the Rotary Club of Norwich, Conn. He also prepared a paper, "The Isolation of the Tubercle Bacillus," which he read before the Association of Public Health Laboratories, Middletown, Conn.

* * * *

In May, 1936, the H. W. Wilson Company published the *Educational Film Catalog* to aid schools, clubs, churches and various institutions in locating and selecting the latest and best films to use with all courses of study and for program planning. This *Catalog* will be kept up to date with supplements beginning in January and published quarterly thereafter. Films are listed in classified order with notes to show what the film is about and where it would be most useful. All necessary information for obtaining the film is given and there is no charge for this listing. If you have films which you want listed in this *Catalog*, write to Miss Dorothy E. Cook, care of H. W. Wilson Company, 950–972 University Avenue, New York City.

You have all seen *Life Magazine*, and may be considering sending in some of your work. The man to send it to is:

Mr. Willard D. Morgan,
Contributions Editor,
Life Magazine,
135 East 42nd Street,
New York, N. Y.

Mr. Morgan writes: "*Life* seeks vivid, accurate, coherent pictorial stories of significant current researches in every field of science, including every branch of medicine; picture reports of scientific explorations, archeological and other scientific expeditions, comprehensive pictures of important new inventions, processes. It welcomes picture sequences progressively showing the habits or life cycles of insects or animals, plants, human beings; arresting, if possible instructive, single pictures of extraordinary incidents or things wherein science is an important factor.

Life is glad to have you submit your photographs. However, *do not* clean out your old files and albums for pictures that are worthless. Be the first to judge and edit your photographs. Ask yourself whether they are of the stuff hundreds of picture readers want to look at. Higher rates are paid for exceptional photos, when *Life* finds them to be of extra value."

For specific information or further information on pictures other than scientific, write to Mr. Morgan.

* * * *

Happy thought:—why not have your JOURNAL bound? Mr. M. G. Schneckenburger of East Aurora, N. Y., writes that he has just had the first four volumes bound by the Roycroft Press there, and is delighted by their looks and convenience. No more danger of mislaying a number, or having a shelf-full of scattered numbers all out of sequence. Incidentally when you take them out to have them bound, look over the back numbers again. There is more in them than you remember!

* * * *

At various times during this past winter, members have written to the Secretary asking for help on questions of equipment or technique. She has forwarded these questions to other members in similar fields of work, sometimes referring the same questions to several other workers. In every case the members have replied, answering the question to the best of their ability, often including drawings, photographs, articles, and bibliographical references. This is the spirit of coöperation at its best, and in itself justifies the founding and continuance of this Association. On her behalf the Secretary wishes us to extend her thanks to the members for the prompt, thorough consideration they have given the questions referred to them.

* * * *

Excerpt from *The Film Daily*, motion picture trade paper:

" 'Trailing the Sea-Horse.' . . . Splendid. The ocean floor has few forms of life as intriguing as the diminutive sea-horse. Although a popular exhibit at most major aquaria, there are few visitors acquainted with its natural habitats and

habits. Nature Film Company has something of a scoop in this reel, which will grace any theatre screen. Audiences are shown the sea-horse in its exhibition tank at New York's famous aquarium, and are then transported to nearby Sayville, L. I., and aboard Captain Daniel Collins' boat. Into Great South Bay a diver and drag-net are lowered. There in the eel grass are sea-horses. Underwater shots are very interesting. Clear photography and well-devised narration contribute to enjoyment of this splendid subject."

This film was photographed by our member, Mr. S. C. Dunton, photographer at the New York Aquarium, and one of the founders of Nature Films Company. Mr. Dunton writes us that the film had a very successful premier at the New York Translux Theatre. Nature Films Company installed a tank of live sea-horses in front of the theatre for the opening, and the little hippocampi drew enough crowds to delight the manager, who declared it was "the best publicity stunt ever pulled on Broadway."

* * * *

We welcome the following new members to our Association:

Burdick, Prof. H. O.,
Alfred University,
Alfred, N. Y.

Caldwell, Chas. S., M.D.,
Homeopathic Hospital,
Pittsburgh, Pa.

Daily, Roy K., M.D.,
1117 Medical Arts Building,
Houston, Texas

Dodds, Thomas Cairns, M.D.,
Pathology Department,
Medical Buildings,
University of Edinburgh,
Edinburgh, Scotland.

Donaldson, John C., M. D.,
Dept. of Anatomy,
University of Pittsburgh,
Pittsburgh, Pa.

Friesell, C. E.,
School of Dentistry,
University of Pittsburgh,
Pittsburgh, Pa.

Groves, Hugh,
Eastman Kodak Stores, Inc.
Pittsburgh, Pa.

Jacobs, William F., M.D.,
408 Richmond Avenue,
Buffalo, N. Y.

Knapp, Alphonse J., M.D.,
524 Market Street,
East Liverpool, Ohio

Koenig, A., M.D.,
121 University Place,
Pittsburgh, Pa.

Leming, M. F.,
907 Broom Street,
Wilmington, Delaware

Magill, Miss Inez,
611 Wentzel Avenue,
Pittsburgh, Pa.

Netting, Mr. M. G.,
Carnegie Museum,
Pittsburgh, Pa.

Oliver, Richard,
Brooklyn Eye and Ear Hospital,
Brooklyn, N. Y.

Pathological Laboratories,
St. Johns Hospital,
480 Herkimer Street,
Brooklyn, N. Y.

Pilcher, John F., M.D.,
920 Avenue B,
Galveston, Texas

Randall, Miss Lillian Pauline,
749 Fairmont Avenue,
Pasadena, Calif.

Ross, Mary Ellen,
Homeopathic Hospital,
Pittsburgh, Pa.

Ross, Nicholas E.,
450 West 162nd Street,
New York, N. Y.

Shirer, John W., M.D.,
5070 Jenkins Arcade,
Pittsburgh, Pa.

Thorp, Prof. George B.,
Carnegie Institute of Technology,
Pittsburgh, Pa.

Waters, Louis A.,
Chamber of Commerce Building,
Syracuse, N. Y.

Goldsmith, Norman, M.D.,
Pittsburgh Skin and Cancer Foundation,
Pittsburgh, Pa.

Simon, R. J., M.D.,
Mercy Hospital,
Pittsburgh, Pa.

Mellon, Ralph, M.D.,
West Penn Hospital,
Pittsburgh, Pa.

Lehle, William L.,
514 Park Avenue,
Wilmette, Ill.

Barrett, Mrs. Miriam R.,
Department of Pathology,
University of Pennsylvania Medical School,
Philadelphia, Pa.

* * * *

The value of photography in scientific research is being recognized more and more. Dr. Davenport Hooker, Professor of Anatomy at the University of Pittsburgh, and Chairman of the Pittsburgh Chapter, is making a motion picture film on the development of the central nervous system as an integral part of his studies. The American Philosophical Society has recently made him a grant for the purpose of financing the photographic record of his work.

* * * *

One of our members, Mr. George Ryan, is striking out for himself and opening an office for complete 16-mm. service. He is fully equipped to take motion pictures, including medical and biological subjects, sound or silent, black-and-white, or color. We wish him every success. His new offices are in the Fulton Building, Pittsburgh.

Arthur W. Fuchs
343 State Street
Rochester, N. Y.

VOLUME V *June, 1937* NUMBER 4

The Journal of the
Biological Photographic
Association

A PRACTICAL TECHNIQUE OF PHOTOGRAPHY FOR USE IN THE SURGICAL OPERATING THEATRE*†

H. S. HAYDEN

Montreal, Canada

The urgent necessity for photographic records in neurosurgery has brought about the invention of an entirely new apparatus eminently suited to the production of photographs, not only as records of surgical procedure to be used for explanatory and instructional purposes, but also in many cases, as illustrated by recent developments, as an integral part of the scientific analysis of the findings of the operating surgeon.

Our early ventures into this special branch of photography presented many problems and difficulties arising from the inadequate forms of artificial lighting systems. These were due to the lack of recent developments of slow and noncolor sensitive negative material, the difficulty of obtaining a viewpoint clear of the operating surgeons and the cardinal necessity of preventing the camera, essentially a dust-catching piece of apparatus, from introducing impure particles into the area of sterilization.

The first and second of these problems have been overcome to a great extent by the marked advancements made by the manufacturers of photographic emulsions. The production of hypersensitized films and

* From the Photographic Department, Montreal Neurological Institute, McGill University.

† An article on the same subject by Mr. Hayden appeared in the Photographic Journal of the Royal Photographic Society, Vol. 76, April, 1936.

plates, sensitized to the red rays in which incandescent lamps are especially rich, has for the past few years speeded up the exposure problem for interior photography sufficiently to make it practical and successful. This situation has been further aided by the recent invention of the Photoflood lamp in which an incandescent filament is burned at double the voltage it was originally designed to burn. As a result the life of the bulb is shortened but the actinic brilliancy is increased seven or eightfold. To obtain corresponding advantages of shortened exposure, when using negative material not hypersensitized to red rays, would clearly have involved the use of some illuminant correspondingly rich in blue-violet or blue-green emanations, and some such device as the open arc or the mercury vapor lamp would have been indicated. The former was, in fact, considered but was of necessity abandoned in consequence of its practice of throwing off particles of dust, carbon, and often impurities from its glowing electrodes. The mercury vapor lamp was considered to have corresponding disadvantages, due perhaps to the flickering and unsuitability to the special requirements of the operating room.

Furthermore, when photographing surfaces which are clouded by a film of blood most of the time, it is advantageous to use an illuminant having a preponderance of red rays which are capable of piercing the film of blood and revealing to the camera's eye the necessary details it covers. Mention must be made of the recently perfected infra-red plates and films, the possibilities of which were investigated as it was thought that they would be helpful in the photography of surgical operations. With certain exceptions, however, it has been found that the extreme contrast of the results, due to the fact that practically monochromatic light is being photographed, and the somewhat slow effective speed of the plate and its special filter, weigh against its usefulness in this field. Furthermore, the complete absorption by the infra-red filter of all except the extreme red rays precludes the successful recordings of fine details of red or reddish hue.

In reference to the problems regarding the mechanical arrangements for the camera itself, it was necessary to resort entirely to building it to the requirements of the lens and the size of the plates to be used. In the first attempt at surgical photography a camera of the field type having a telephoto lens of 18 inch equivalent focus was used. It was set up in the operating theatre to one side of the operating table and at

a distance suitable to the preservation of the sterile field, the actual distance allowed being five to six feet. This introduced the disadvantage that the image so obtained, even with the telephoto lens, was not of sufficient size to give the results desired. Moreover, although the fullest use was made of all the back, front and bed adjustments of the camera, it was found impossible to obtain a suitable angle of view for all the various positions of the patient's body during the progress of the operation. By the very nature of the work to be performed the various junctures at which the surgeon may desire a photograph to be taken are almost impossible to foretell, and the allowable interruptions to the surgeon's work are of necessity too brief to permit of a complete new setup of the equipment for each exposure. However, the results were promising enough to overcome the obstacles produced by these makeshift experiments; even the possibilities of good color transparency plates were sufficiently gratifying to lead to a technique for a more permanent apparatus without, if possible, the shortcomings previously referred to.

Roughly, the desiderata are as follows: The photographer and as much of his equipment as possible must be effectively screened from the operation, and such of the equipment as does project into the vicinity of the sterile field must be capable of being rendered and kept in a state of scrupulous cleanliness. The optical system should be equipped to produce critically defined images, preferably up to approximately full scale of the operation area. The apparatus must be capable of adjustment to a wide variety of angles of view without any major change in the position of the camera itself. Such adjustments, together with the ordinary adjustments of focusing, etc., should be made while the surgeon is at work, so that the apparatus will be ready at a moment's notice to make an exposure upon receipt of the surgeon's signal. Finally, the entire apparatus must be sealed off from the sterile field in the main body of the operating room.

These being the generally accepted conditions it is not unnatural that attention should be directed towards mirror photography, in which advantage is taken of the fundamental laws of reflection and incidence to obtain a change in viewpoint without a corresponding change in camera position. A mirror is used to deflect, through a suitable angle, the light rays proceeding from the subject to be photographed before they actually enter the lens and form an image upon the plate. The

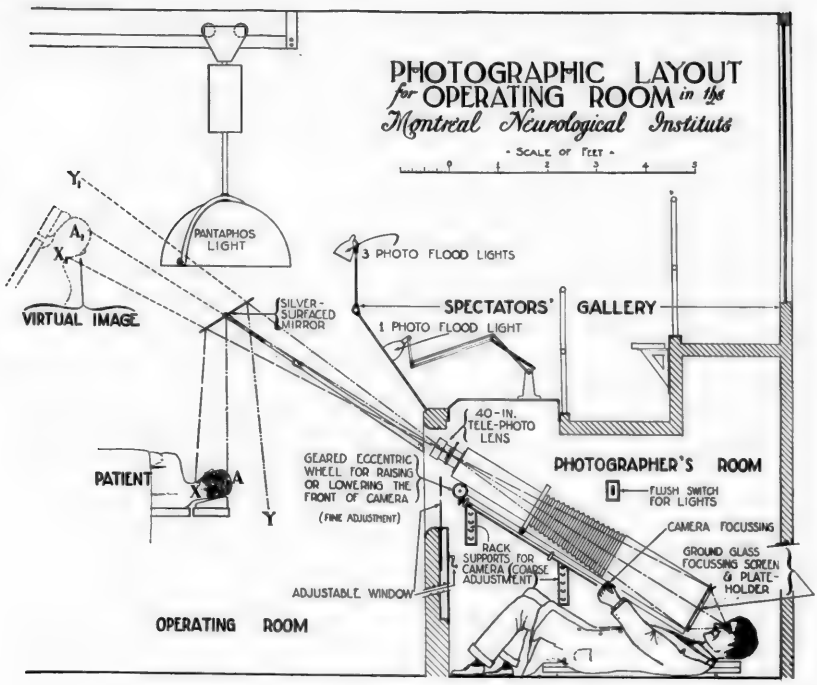

PHOTOGRAPHIC LAYOUT
for OPERATING ROOM in the
Montreal Neurological Institute
- SCALE OF FEET -
0 1 2 3 4 5
PANTAPHOS LIGHT
3 PHOTO FLOOD LIGHTS
SILVER-SURFACED MIRROR
VIRTUAL IMAGE
SPECTATORS' GALLERY
1 PHOTO FLOOD LIGHT
40-IN. TELE-PHOTO LENS
PATIENT
GEARED ECCENTRIC WHEEL FOR RAISING OR LOWERING THE FRONT OF CAMERA (FINE ADJUSTMENT)
PHOTOGRAPHER'S ROOM
FLUSH SWITCH FOR LIGHTS
CAMERA FOCUSSING
GROUND GLASS FOCUSSING SCREEN & PLATE-HOLDER
RACK SUPPORTS FOR CAMERA (COARSE ADJUSTMENT)
ADJUSTABLE WINDOW
OPERATING ROOM

FIG. 1

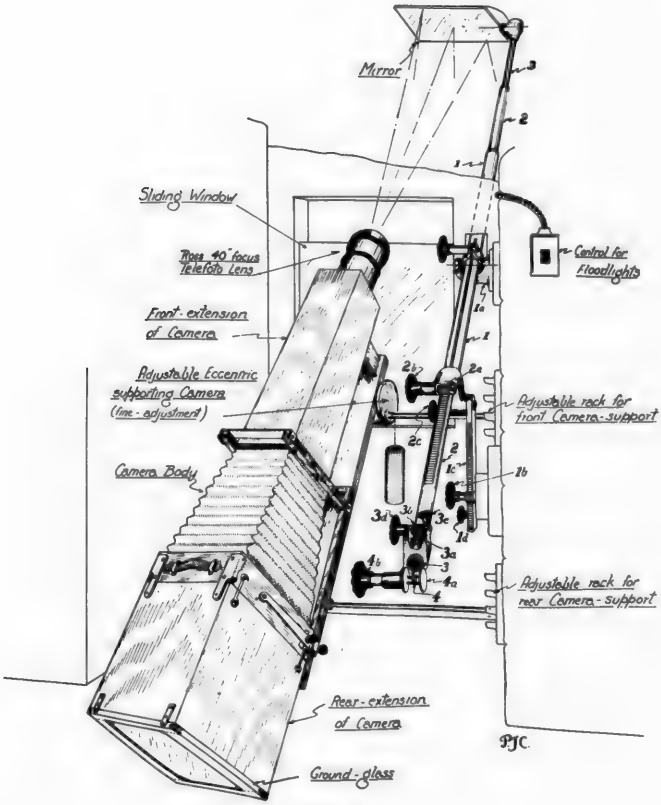

Mirror
Sliding Window
Zeiss 40" focus Telefoto Lens
Front extension of Camera
Adjustable Eccentric supporting Camera (fine-adjustment)
Camera Body
Control for Floodlights
Adjustable rack for front Camera-support
Adjustable rack for rear Camera-support
Rear-extension of Camera
Ground-glass
PJC.

FIG. 2

photographer focuses upon a virtual image in the mirror but obtains a real image, laterally reversed, upon the ground glass of the camera. This type of photography has been used for many years by photoengravers where, however, its object is to obtain the lateral reversal required by certain printing methods and inherent in mirror photography. Its object in the Neurological Institute is to secure an approximately vertical effective viewpoint without actually mounting the camera in the ceiling, and the lateral reversal in this case is an accepted drawback which may be readily corrected in the enlarging or other secondary processes.

The sectional drawing (fig. 1) indicates the apparatus as arranged in the operating theatre of the Institute. The photographer's room is located immediately beneath the visiting surgeons' gallery, and its only connection with the well of the theatre is by a sliding plate glass window which can be opened or closed from the photographer's room. Behind this window, tilted at a variable angle, is the camera itself, consisting of an 8 by 10 inch standard field camera fitted with very generous front and rear extensions of mahogany, the whole assembly carried on a rigid subbed of wood. This subbed in turn is mounted on a pair of steel rods carried in cast iron brackets and provided with fine and coarse adjustments for the tilt of the camera. Mounted in the front extension of the camera is a 40 inch telephoto lens working at f:8, together with a shutter operated from an air tube and bulb. The exceptionally long focus lens has been found suitable for copying at full scale and is most commonly used at an aperture of f:11, which affords a sufficiently deep field of focus for most purposes. The photographer is provided with a rolling stretcher on which he can lie at full length under the camera, all controls being then within his reach.

The mirror itself is mounted outside the glass window in the operating room proper, just below the lighting unit of the main operating room. It consists of a sheet surface, optically silvered, flat plate glass, 12 by 18 inches in size. The preliminary trials were conducted with the mirror mounted on a wooden standard, and the results were considered to justify the somewhat elaborate final mounting arrangement.

The mounting of this permanent mirror is clearly shown in the drawing (fig. 2). It consists essentially of a series of telescoped steel tubes arranged to project through the wall from the photographer's room to the operating room, and carrying the mirror at one end and the

control handles at the other. The outer and largest tube (1) is carried on a short horizontal trunnion just inside the wall and permits the whole system to be tilted through a considerable angle. This tilting is controlled by a small wheel (1b) acting through a rack and pinion (1c) and locked in any desired position by means of a binding nut (1d). The second tube (2) slides within the outer tube (1) and has a rack cut in its upper surface. This rack is engaged by a pinion (2a) turned by a wheel

FIG. 3. LEFT PARIETAL OSTEOPLASTIC CRANIOTOMY AND REMOVAL OF CICATRIX
Photograph taken during operation

(2b) so that the tube (2) can be made to project a greater or lesser distance into the operating room; this motion is locked by a binding nut (2c).

The third and innermost tube (3) twists within the second tube (2) and is fitted at its outer end with a housing carrying the mirror on a short axle. The inner end of the tube (3) has cut in it a worm gear (3a) engaged by a worm (3b), so that by turning the wheel (3d) the mirror may be sleeved about the axis of the tube system; a binding nut (3e)

serves to lock the tube (3) in position. Running inside the innermost tube is a cord (4) wound on a short drum (4a) and secured at its far end to the mirror system, so that when the drum is turned by means of the wheel (4b) the mirror is tilted about its own axis.

The mirror is thus provided with a full range of movements enabling it to collect and deflect the rays from a complete variety of viewpoints into the camera lens. Attention has also been given to the design of

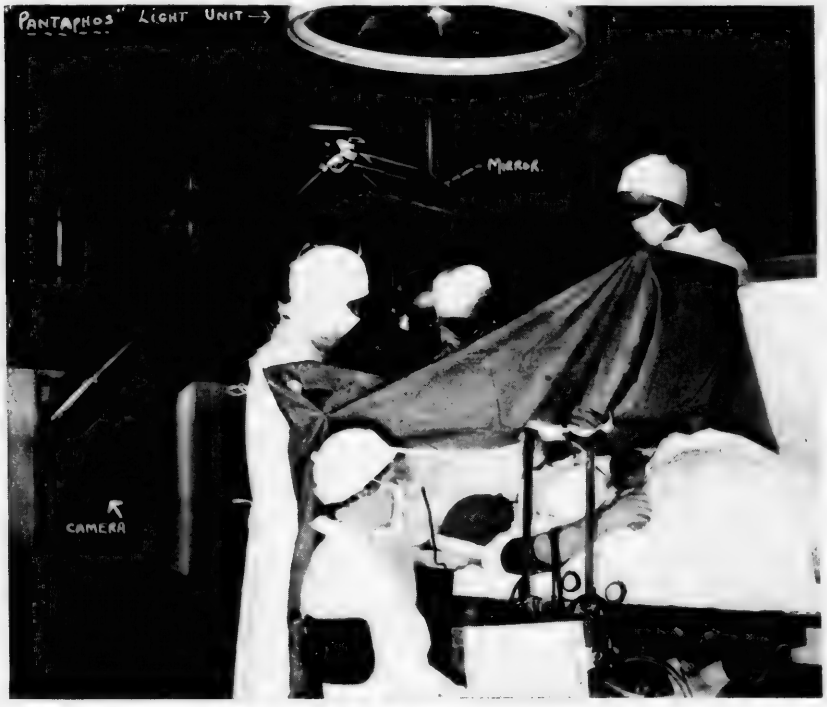


FIG. 4. OPERATING ROOM SET UP SHOWING POSITION OF CAMERA AND MIRROR

that part of the mirror and mounting which projects into the operating room, to insure that no dust or metallic particles will be shed into the operating field when adjustments are being made. The back of the mirror has a smooth, rounded contour, while the housing for the axle is of a totally enclosed design. The whole is coated (except, of course, the optical surface of the mirror) with a film of glycerin during operation as a further preventive against the shedding of dust. All parts of the

mounting which project into the operating room are of nickel-plated metal and highly polished.

Mention has already been made of the advantages of Photoflood illumination when used in conjunction with the highly red-sensitive negative materials now available. It should be borne in mind, however, that a source of brilliant illumination exists in the Pantaphos ceiling unit which provides the working light for the surgeon. The auxiliary light sources required to build up the illumination to a strength suitable to photography had to be carefully coordinated with the central unit. The Pantaphos unit is provided with a large bowl reflector arranged to focus the complete light output from the outer zone of the reflector on to a comparatively small area which is to be illuminated. The photographic mirror can be placed so that it occupies a position immediately below the central position of the Pantaphos reflector, thus cutting off little or none of the working light. Auxiliary lights consisting of four Photoflood lamps in bowl reflectors and two concentrated spotlights are used. These are mounted at convenient points in the operating theatre. The Photoflood lamps are controlled from the switch in the photographer's room. For results to be obtained in monochrome, hypersensitive and supersensitive panchromatic backed plates or films are generally used together with a variety of correction filters such as K 1, K 2 and K 3. The filter for color plates is, of course, adjusted to the brand of material and artificial lighting used. With this combination and the lighting equipment already described, exposures of from $\frac{1}{8}$ second to 1 second at f:11 (or the equivalent at smaller or larger apertures) have been found to afford good results. In order to prevent impairment of detail by the somewhat coarse emulsion structure inherent in high-speed plates recourse is had to fine-grain developing methods, and a negative should be obtained which is suitable for enlargement. Figure 3 is typical of the result obtained.

In conclusion, a point of interest which may be mentioned is that of the maintenance of the mirror in good condition. Since this mirror is actually a component part of the optical system of the camera, it is of paramount importance that its surface be kept in an optically perfect condition, particularly in the matter of color photography. Until recently, when the surface of the mirror became discolored due to oxidation from fumes and the steamy atmosphere of the operating room, periodic recoating of the silver-surfaced mirror was found necessary.

This, however, was expensive and inconvenient and resource was made to a chro-luminum coating, which is a triple coating of aluminum, chromium and aluminum. The aluminized surface can be washed with distilled water or alcohol and dried with medical cotton without injury to the surface. It has a reasonably long life and is quite inexpensive.

TABULAR AND TEXTUAL LANTERN SLIDES*†

RICHARD M. HEWITT

Rochester, Minn.

Editor's Note: This article has been previously published in the American Medical Association Bulletin for December, 1936, Vol. 31, No. 9. Due to its great value and interest to biological photographers it is herewith reprinted by the kind permission of the author and publisher.

Dr. West assigned to me a title which was considerably broad. He referred, however, to a conversation I recently had with Dr. Fishbein, from which I had gained the impression that if I could contribute anything which would be of value to you it might be by relating what I have had to learn concerning the preparation of copy for textual and tabular slides. I shall come to that in a moment but, with your permission, I shall say something else first.

Whatever this headquarters' office may be to others, it is alma mater to me. This is my homecoming, although football and conviviality have no place in it. It was easy to get my class together for this occasion because I was the only freshman who matriculated when I did. My reunion must be with the faculty and with those who were upper classmen when I was a freshman. But because it is the custom at a time of reunion and because before now I have not had the opportunity, more or less publicly, to say how highly I regard this office and those who work here, I should like to reminisce a little.

Almost exactly eleven years ago, having done more than my share of academic roving on both sides of the desk, and a number of other things, I entered, on this site, a red brick building which I am told is the same one where we are meeting today. It looked very, very different eleven years ago. Dr. Fishbein had taken me on as his assistant editor of *The*

* From the Division of Publications of The Mayo Clinic.

† Read before the Annual Conference of Secretaries of Constituent State Medical Associations, Chicago, Nov. 16 and 17, 1936.

Journal. I wonder at it. All I had or pretended to have was a good fundamental training, a zeal for the job and a desire to continue to eat. But he took me on, taught me, let me learn and set me an example of brilliancy and hard work that I have not seen equaled.

I remember the first day. It dawned on me with something of a thud that a large part of my work would consist of seeing to it that proof reached the printers in such time and in such form that they could use it. To me, at that time, printing was an occupation once followed by Benjamin Franklin. Nevertheless, Miss Whelan showed me how to make a schedule, what to do with it and how the schedule was related to the proofs, some of which were on my desk and others round about the building in departments of which I never had heard. Then I went downstairs to the make-up bank.

"Mr. Foley," I said, "I don't know anything about all this." I waved my hand generally about the big composing room. "Tell me what I need to know as I go along, will you?"

"Sure I will, Doctor," said the man who soon let me call him "Bill," and he did tell me. I did not learn printing, for I did not have a lifetime to give to the task, but I learned what I needed to know, mostly from Mr. Foley but some, also, from Mr. Bryant, head manuscript editor, and from Messrs. Harris and Williams, at that time respectively assistant superintendent of the printing department and foreman of the composing room. Once I learned some biology from Mr. Lyon, the head proofreader. Without consulting a book he diagrammed for me the mouth parts of a mosquito, and I had served my hospital internship in the tropics at that. Those men could have made my life miserable if they had wished to, but they were not that kind of men.

Then, after I had written my first signed article for *Hygeia* and was a little elated because of it, Dr. West called me into his office. He looked about as warm as winter is where I live now.

"Hewitt, how do you know that?" he asked, with a long thin finger pointing at a phrase I had written. And I did not know it. It just seemed likely. I changed it.

In the course of what might be called my initiation I encountered, also, Professor Puckner. Some of you knew him. With a desire only for information, but apparently with an inflection I did not intend, I asked him why the Council had turned down a certain product.

"Well," he began, "perhaps you know more about it than the referee."

And so it went. My chief, Dr. Fishbein, would let me say to him anything I thought and then tell me what he thought of it and of me, very frankly indeed. Soon I came to understand that I was associated with the most hard-boiled, most frank, most sincere lot of well wishers to men of good will with whom I ever had worked. It was a great school, a very great school, and my zeal for the job increased, so that I have remained a medical editor.

With what that means, you are acquainted. And you are aware that the medical editor is expected to know, or to know where to find out everything, whether of medical interest or not, which does not come within the field of an expert in some branch of science. Should the caduceus be represented with one snake or two? What is the height of the Eiffel Tower? Who was the Surgeon General of the Army in 1898? Was it Cutty Hunk or Mauch Chunk from which the Wright brothers took off, or if it wasn't either where was it? And perhaps it wasn't the Wright brothers but only one of them, and if so which one?

THE EDITOR LEARNS ABOUT LANTERN SLIDES

So it came about that my great predecessor in the Division of Publications of The Mayo Clinic, Mrs. Wilson, was asked to take the responsibility for the preparation of copy for nearly all lantern slides of a tabular or textual nature used by speakers of the staff of the clinic. She had to find a suitable paper, a suitable typewriter and a suitable technic, and the materials which she adopted and the routine she set up are still in use.

MATERIALS AND TECHNIC

At the Clinic, last year, we made the copy for 1,145 tabular or textual slides. With an amount of work as large as that to do, we have to employ the quickest adequate method. Copy for all of our tabular and textual slides, therefore, is made on a typewriter, although ruling is done by hand in india ink.

The type is a standard pica style for general purposes. It is kept scrupulously clean, and the highly expert women who do the typing are strong in their praise of a type cleaner made of kneaded rubber.[1] We type through a fresh, black ribbon on paper[2] which is rather stiff, which does not wrinkle and which is generally of the proper characteristics for

[1] Star type cleaner, manufactured by Faber.

[2] Substance 28 white Treasury Ledger paper.

photographic work. One carbon copy, a necessity with us, can be made through this paper.

LEGIBILITY OF CHARACTERS

From the time when our division took over the preparation of copy it was generally understood that speakers should not "put too much on a slide." However, what was understood in principle was not always followed in practice, and then something happened. Several members of our staff were invited to appear at a meeting of an organization which goes in for somewhat formal addresses. These addresses are in the nature of inclusive reviews and are delivered before audiences of several thousand people. In preparing their reviews, the invited members of our staff were able to use several slides which they had prepared for shorter talks on particular aspects of the broad subjects which had been assigned to them. These slides had been legible to smaller audiences, but they were not legible from the back of the large auditorium where the meeting of which I have been speaking was held. It became necessary to determine some quantities.

Plummer Hall, the largest auditorium at the Clinic, was available as a place in which to work, and with the help of Mr. Julin, head of the photographic department at the Clinic, of Dr. Sheard, whose specialty is physiologic optics, and of Dr. Prangen, ophthalmologist, several facts were gathered.

The ophthalmologist knows that on the charts which he uses in refraction the letters are designed to subtend an angle of 5 minutes at various distances from the apex of the angle. The apex of the angle is at the eye of the observer. The big letter at the top of the chart subtends an angle of 5 minutes at 200 feet, and the letters in the third line from the bottom of the chart subtend an angle of 5 minutes at 20 feet. The person who can read the letters at the distance from which they were designed to be read is said to have normal vision. It would seem therefore that if characters cast by a lantern on the lighted screen of an auditorium were designed to subtend an angle of 5 minutes, when the apex of the angle was on the line of the rearmost row of seats in the auditorium, the characters would be visible to any one with normal vision who was seated in one of that rearmost row of seats and, therefore, to all other members of the audience whose vision was normal. To one who, besides accepting these principles, also is anything of a rifleman, the

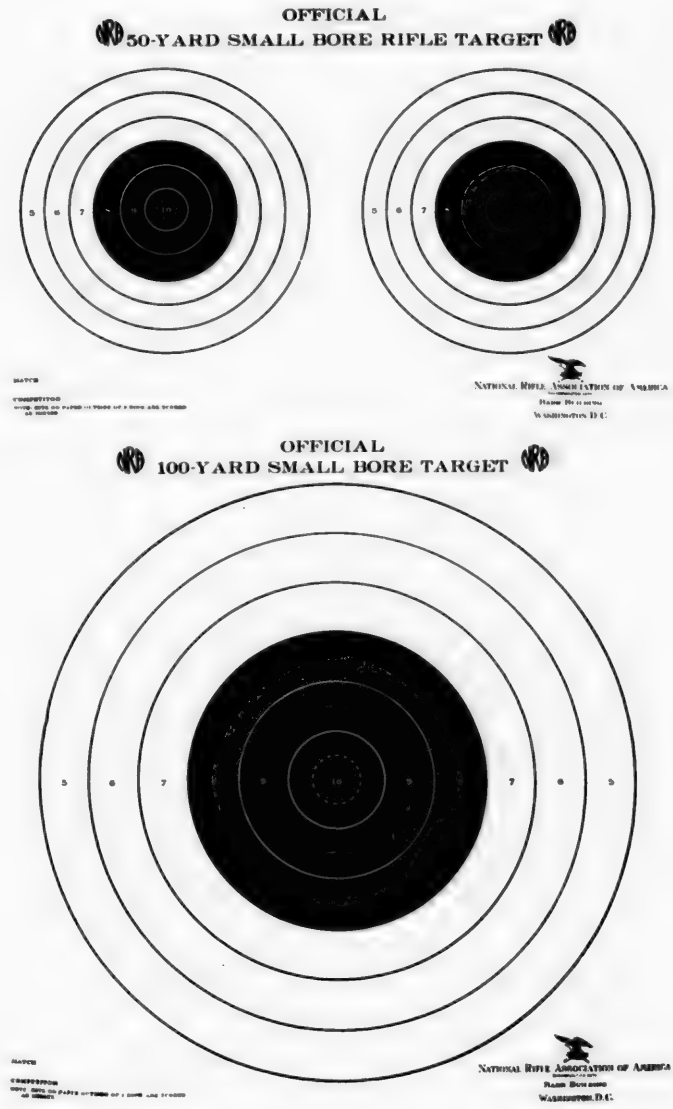
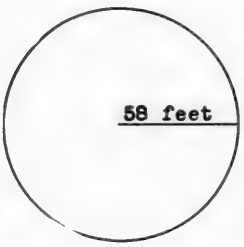


FIG. 1. Official 50 yard and 100 yard small bore rifle targets, reduced

foregoing assumption would seem doubly justified. The rifleman knows that the central black area on the official small bore rifle target subtends an angle of approximately 5 minutes at the range for which the target is

designed (fig. 1). These black areas are easily visible from the appropriate firing points.

As I have said, Plummer Hall was available to me. In this hall the distance from the screen to the rearmost row of seats is 58 feet. The



$\pi = 3.14$

$2\pi r$ = circumference

2x3.14x58 = 364.24 feet in the circumference

364.24÷360 = 1.01 foot in 1 degree

1.01x12 = 12.12 inches in 1 degree

12.12÷60 = 0.20 inch in 1 minute

0.20x5 = 1.0 inch in 5 minutes

FIG. 2. How to calculate the width of an angle of 5 minutes, 58 feet from its apex

The medical historian of the future probably will refer to the past fifty years as marking an era of unprecedented advance in all branches of medicine, and will hazard the prediction that it is doubtful if equal progress ever again will be made in the same period of time. Certainly in the field of surgery such a prediction seems well founded. In this era the great accomplishments of surgery have been made because anesthesia and asepsis made possible the application of knowledge of pathology, physiology, biochemistry, and roentgenology, and in turn a deliberate, scientific, and safe approach to every part of the body. Much of the extraordinary development in the knowledge of disease can be attributed to the fact that surgery provided a method by which the "pathology of the living" could be completely revealed and its effects studied. In the beginning of this era surgical exploration all too frequently revealed a condition which was obviously the terminal stage of a lesion that might have been satisfactorily dealt with in its incipiency. Surgery, therefore, can be credited with giving the impetus to clinical and laboratory methods of identifying lesions in the early stages of their evolution; in some fields, surgery made possible recognition of the conditions under which lesions may occur. Thus, surgeons of all countries have added to knowledge of disease in its various stages, and the ready availability of reports of observations made the world over has placed the present era in surgery in so distinguished a position.

Innumerable examples could be cited to illustrate the progress of surgery during this period. Major surgical procedures are now carried out with such safety that the predictions of surgeons only a few years ago are forgotten. The great surgeon Langenbeck, when Billroth was endeavoring to find a safe method of resecting the stomach for cancer, stated that he looked on the attempt as "only a quicker way of taking out of the world a patient whom it is impossible to save." Yet today this operation is routinely performed, with a resulting definite percentage of cures in cases of malignant disease and with consequent restoration of health to those who have benign lesions. Again, it is a far cry from the times of John Hunter who said, "To perform an operation is to mutilate a patient we cannot cure; it should therefore be considered as an acknowledgment of the imperfection of our art." The most significant trend of surgery has been the attempt to control, ameliorate, abort, and prevent those conditions which are known, or suspected, to be dependent on disturbed physiological processes. In the treatment of peptic ulcer, for example, the attempt to achieve by surgical measures the ideal in management of the disease -- to effect permanent inhibition of a hyperactive function, particularly of the secretory mechanism -- has resulted in the employment of a number of procedures to bring about such control in the simplest and most physiological way. The surgery of the sympathetic nervous system is an entirely new approach to the treatment of those diseases which are characterized chiefly by vasomotor spasm, and the future developments in this field of surgery probably will be as startling as those that have already been made. Again, the attempt to employ a similar method of approach in treatment of those conditions which may be dependent on normal or abnormal activity of the ductless glands, may open up great possibilities for the surgical treatment of a wide variety of conditions which may be attributable primarily to altered physiological function, particularly of the vasomotor system.

The factors contributing to these great advances in surgery have come from every field of medicine. As already has been pointed out, surgery, in revealing the actual disease, gave the initial impetus to a more exact knowledge of disease. But second only to surgery have been the roentgen rays. The place of roentgenology in the diagnosis of lesions in every region of the body cannot be overestimated. Not only have these rays made possible detection of lesions before any method known at present can detect them, but, with biopsy and knowledge of cellular differentiation, accuracy in prognosis has been immeasurably improved. The fact that by roentgen rays lesions can be identified before clinical manifestations are present, has been an enormous benefit to mankind in making possible early and effective treatment. The recognition of pulmonary tuberculosis

FIG. 3. The area of a slide filled with characters arranged in forty-eight lines. When projected, the characters subtend an angle of 5 minutes at 58 feet.

first problem then was to find the width of an angle of 5 minutes, 58 feet from its apex. This problem can be worked by trigonometry if one prefers trigonometry. However, Mr. McKenzie, of the Section on

Biochemistry in The Mayo Foundation, showed me how to make the determination by simple arithmetic (fig. 2).

An angle of 5 minutes, as is evident in figure 2, is 1 inch wide, 58 feet from its apex. In Plummer Hall the illuminated area on the screen, when a slide is in the carrier, is 8 feet high. There are 96 inches in 8 feet. If as much space is left between the lines of type as the characters are high, there is room in the illuminated area for half as many lines of type 1 inch high as there are inches in the height of the illuminated area, or forty-eight lines of type. In other words, in Plummer Hall, each character on a slide of forty-eight lines (fig. 3), when projected, will subtend

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FIG. 4. The area of a slide filled with characters arranged in thirty-two lines

an angle of approximately 5 minutes, and one would think such characters would be easily visible from the rear of the hall.

A person who is seated in the rear of Plummer Hall, if his vision is normal, can read that slide when it is projected, but he would not read it and probably he could not read many such slides. There is a certain amount of glare, the auditorium is not pitch dark, and the contrast between white and black is imperfect. Ocular fatigue, accordingly, results. A slide which contains thirty-two lines of type is more easily read (fig. 4), but those of us who have worked on the problem consider from twenty to twenty-five lines about the maximal number for projection in Plummer Hall. Figure 5 is a slide of twenty-four lines, half

of forty-eight; the characters on this slide therefore, when projected, subtend an angle of 10 minutes; they are twice as large as would seem arithmetically necessary.

The medical historian of the future probably will refer to the past fifty years as marking an era of unprecedented advance in all branches of medicine, and will hazard the prediction that it is doubtful if equal progress ever again will be made in the same period of time. Certainly in the field of surgery such a prediction seems well founded. In this era the great accomplishments of surgery have been made because anesthesia and asepsis made possible the application of knowledge of pathology, physiology, biochemistry and roentgenology, and in turn a deliberate, scientific, and safe approach to every part of the body. Much of the extraordinary development in the knowledge of disease can be attributed to the fact that surgery provided a method by which the pathology of the living could be completely revealed and its effects studied. In the beginning of this era surgical exploration all too frequently revealed a condition which was obviously the terminal stage of a lesion that might have been satisfactorily dealt with in its incipiency. Surgery, therefore, can be credited with giving the impetu.. to clinical and laboratory methods of identifying lesions in the early stages of their evolution; in

FIG. 5. The area of a slide filled with characters arranged in twenty-four lines. When projected, the characters subtend an angle of 10 minutes at 58 feet.

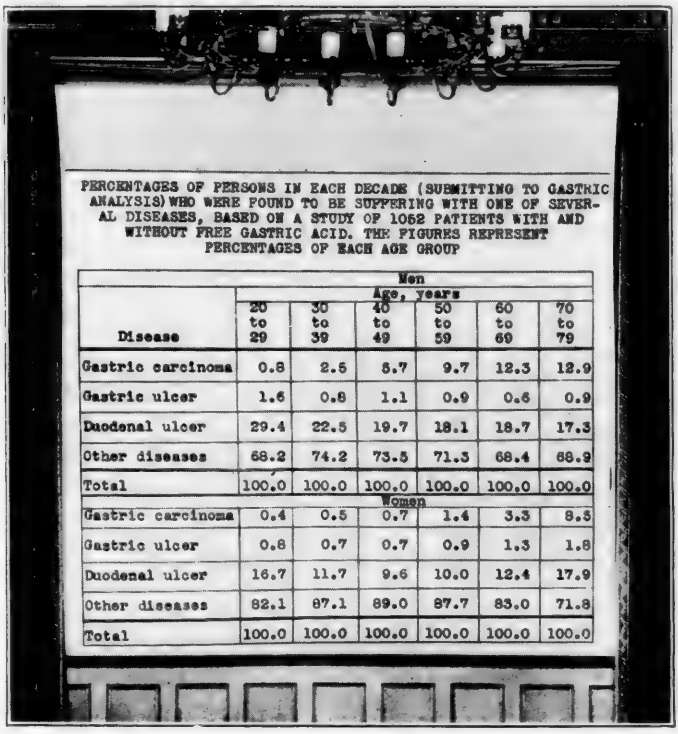
HEAT INJURIES
UNITED STATES NAVY
4,904 Cases
43 Invalided from service
38 Deaths
2,232 Cases 1911 to 1925
218 Sunstroke
864 Heat cramps
1,150 Heat exhaustion
4.5 Average days sick

FIG. 6. A slide of ten lines. There is room in the area of the slide for three more lines of type of this size, without photographic reduction. However, the less there is to read, the easier it is to hold the attention of the audience.

As Mr. Julin has pointed out, the copy for a slide of from twenty to twenty-five lines occupies about a fourth of a sheet of typewriter paper of the usual size ($8\frac{1}{2}$ by 11 inches). When he says that, Mr. Julin is thinking not only of the number of lines of copy but also of the relation-

ship between the height and the width of the area occupied by the copy. A glass lantern slide is $3\frac{1}{4}$ inches high and 4 inches wide. If what has been said in the foregoing paragraphs is to be applied, these relationships must be approximately maintained in the copy.

If the relationships mentioned are kept in mind, what has been worked out for Plummer Hall can be worked out by any speaker for any hall



PERCENTAGES OF PERSONS IN EACH DECADE (SUBMITTING TO GASTRIC ANALYSIS) WHO WERE FOUND TO BE SUFFERING WITH ONE OF SEVERAL DISEASES, BASED ON A STUDY OF 1062 PATIENTS WITH AND WITHOUT FREE GASTRIC ACID. THE FIGURES REPRESENT PERCENTAGES OF EACH AGE GROUP

	Men					
	Age, years					
Disease	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79
Gastric carcinoma	0.8	2.5	5.7	9.7	12.3	12.9
Gastric ulcer	1.6	0.8	1.1	0.9	0.6	0.9
Duodenal ulcer	29.4	22.5	19.7	18.1	18.7	17.3
Other diseases	68.2	74.2	73.5	71.3	68.4	68.9
Total	100.0	100.0	100.0	100.0	100.0	100.0
	Women					
Gastric carcinoma	0.4	0.5	0.7	1.4	3.3	8.3
Gastric ulcer	0.8	0.7	0.7	0.9	1.3	1.8
Duodenal ulcer	16.7	11.7	9.6	10.0	12.4	17.9
Other diseases	82.1	87.1	89.0	87.7	83.0	71.8
Total	100.0	100.0	100.0	100.0	100.0	100.0

FIG. 7. Projection of a well proportioned slide of thirty-one lines, viewed from the front of Plummer Hall.

concerning which he knows the following: (1) the distance from the screen to the rearmost row of seats; (2) the height of the illuminated area on the screen when a slide is in the carrier. Unfortunately, however, the lecturer seldom has this information. If he is to appear under conditions with which he is not familiar, he would be wise to see to it that his slides contain no more than from ten to thirteen lines each (fig. 6). Typed

copy for such a slide, when the lines are not longer than the slide is wide, occupies not more than the area of a slide, photographic reduction is not required and when projected, the material is likely to be visible from the rear of a large auditorium. Furthermore, the audience will not become tired reading it and stop trying to read it.

To demonstrate how certain types of slides appear to the audience under different circumstances, Mr. Julin constructed an exhibit from

PERCENTAGES OF FIGURES IN EACH DECADE (BEGINNING TO GASTRIC
ANALYSIS) AMONG MEN FOUND TO BE SUFFERING WITH ONE OF SEVER-
AL DISEASES, BASED ON A STUDY OF 1000 PATIENTS WITH AND
WITHOUT FREE GASTRIC ACID. THE FIGURES REPRESENT
PERCENTAGES OF EACH AGE GROUP
Men
Age Periods
Disease
Gastric carcinoma 0.8 2.2 5.7 9.7 13.3 12.9
Gastric ulcer 1.4 0.8 1.1 0.9 0.6 0.9
Duodenal ulcer 89.4 87.8 19.7 18.1 16.7 17.3
Other diseases 88.8 74.8 73.8 71.3 68.4 68.8
Total 100.0 100.0 100.0 100.0 100.0 100.0
Women
Gastric carcinoma 0.4 0.2 0.7 1.4 3.5 8.8
Gastric ulcer 0.6 0.7 0.7 0.9 1.8 1.8
Duodenal ulcer 16.7 11.7 9.6 10.0 12.4 17.9
Other diseases 82.1 87.1 89.0 87.7 82.0 71.6
Total 100.0 100.0 100.0 100.0 100.0 100.0

FIG. 8. Projection of the same slide as that represented in figure 7, viewed from the rear of Plummer Hall.

which the next four illustrations are taken. Figure 7 represents the screen in Plummer Hall as it would appear to one sitting in a forward chair. On the screen a slide of thirty-one lines has been projected. The copy for such a slide would cover about half of a sheet of typewriter paper of the usual size ($8\frac{1}{2}$ by 11 inches). Although this slide, when projected, is easily read by one whose seat is forward in Plummer Hall, it is not easily read by one whose seat is in the rear of the same hall (fig. 8). It is not legible at all by one who is sitting in the rear of a large auditorium

if the area of the screen which can be illuminated is not proportionately large (fig. 9). A little while ago I said that from twenty to twenty-five lines is considered about the maximal number for projection in Plummer Hall. Figure 10 is Mr. Julin's demonstration of how a well proportioned slide of twenty-one lines would appear from the rear of Plummer Hall.

So much for slides of which the copy occupies an area not less, or not much less, than that of a slide. Suppose however—and this has been

FIG. 9. Projection of the same slide as that represented in figures 7 and 8, viewed from the rear of a large auditorium.

known to happen—that the speaker submits copy which occupies a very small area and yet is in good proportion. For example, the word "bicarbonate," typed five times, one above the other, occupies a very small area but one of which the height and width are proportional to those of a lantern slide. Therefore, a speaker who presented such copy might ask that it be photographically enlarged so that, when his slide was projected, the characters would be large enough to occupy the entire potentially illuminated area on the screen.

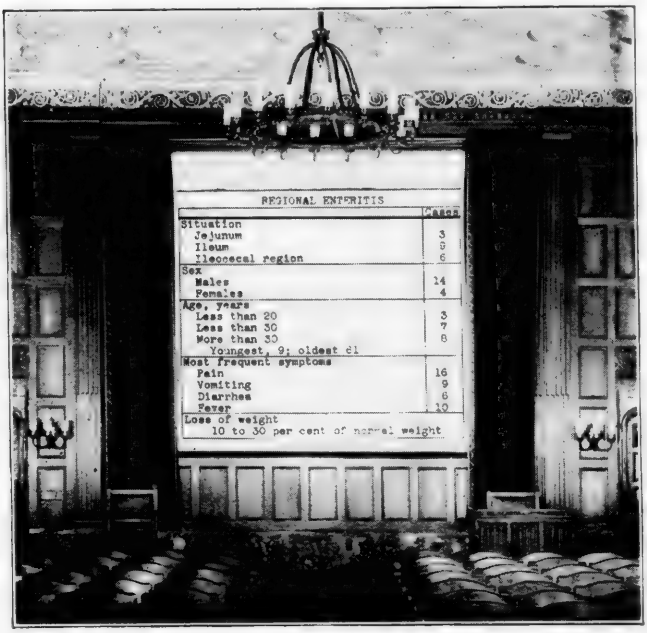


FIG. 10. Projection of a well proportioned slide of twenty-one lines, viewed from the rear of Plummer Hall.

bicarbonate
bicarbonate
bicarbonate
bicarbonate
bicarbonate

FIG. 11. Copy for this slide, containing relatively few characters, was typed in single space in an area measuring $\frac{7}{8}$ by $1\frac{1}{8}$ inch. These proportions practically correspond with those of a lantern slide. The copy was photographically enlarged to fill the area of a slide ($3\frac{1}{4}$ by 4 inches). When the characters were projected on the lighted screen, their edges appeared irregular.

However, if the maximal photographic enlargement is made from copy prepared with the equipment at present available in our division, the result will not be happy (fig. 11). When this slide is projected the effect

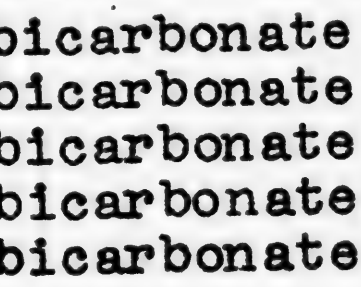


FIG. 12. In this slide, made from the same copy as that from which figure 11 was made, the enlargement was less and the outlines of the characters, when projected, were more distinct but still imperfect.

FIG. 13. A slide of the same import as figures 11 and 12. The copy was made by a sign painter in an area measuring 11 by 13½ inches, was reduced photographically to the area of a slide and when the characters were projected on the screen, their edges appeared sharp.

is even worse than it appears here. Somewhat less enlargement will give a better result (fig. 12), but even in this, when projected and viewed from forward in the hall, the characters appear irregular in outline. In the Division of Publications at the Clinic we may acquire a battery of

typewriters with type of different sizes, or we might find time to use one of the machines designed for printing of show cards. For slides made from small amounts of copy, however, the best results probably will be obtained when the copy is prepared by a sign painter, mechanical draughtsman or printer, using a large card of proper proportions. Figure 13 was prepared by a sign painter on a card measuring 11 by $13\frac{1}{2}$ inches. The copy was excellent, but even if there had been irregularities in the outlines, photographic reduction would have tended to obscure them.

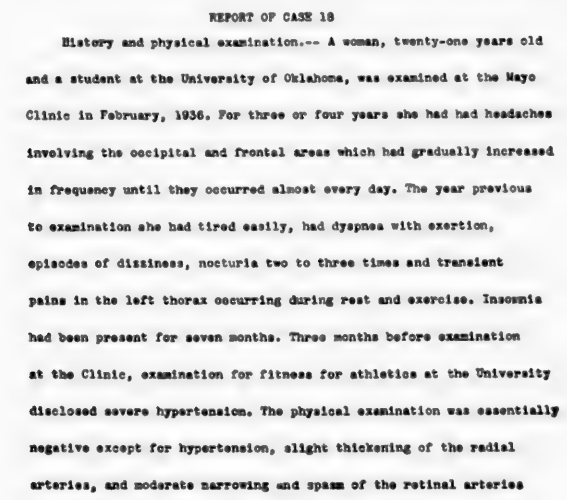
PLANNING THE COPY

Often it seems to a speaker, wearied by days of classifying, eliminating and arranging, that a certain amount of material has been reduced to its smallest possible volume and that it all must appear on one slide. Further study of the material, however, after a period of rest, may disclose that it can be broken down into effective units of two or three slides, which, appearing one after another, will tell a coherent story. Whether the material is enough for several slides or for only one, it may naturally divide itself into several units.

An example will be given in a moment. First, however, I should like to say that in presenting the forty-eight, thirty-two and twenty-four line slides (figs. 3, 4 and 5), the object was merely to fill the available areas with characters. The slides are not good ones, nor was the text of them submitted as copy for slides. However, one who attends medical meetings will be asked to read a considerable number of slides consisting of running text. For instance, if the speaker whose paper contained the report of a case that is represented in figure 14 had allowed the material to be projected on the screen in that form, the effect would have been undesirable. It is well to see to it that a slide looks like a slide; in other words, that it takes on something of the appearance of a table even if it is not genuinely a table. Tabular arrangement helps the beholder to classify what is on the screen. It furnishes successive goals for his eyes and mind and gives him breathing spells between successive ideas. The material shown in figure 14 was compressed and judiciously abbreviated (fig. 15); some non-essential material was omitted, and major divisions were set off by lines. The improvement is evident.

In this connection I may, perhaps, be permitted to say how a slide composed of running text affects me if I am in the audience. If the

speaker throws his text on the screen and then stops speaking, I can read the slide and gain some information thereby. On the other hand, if I am compelled to read one set of words while the voice of the speaker is


REPORT OF CASE 18

History and physical examination.-- A woman, twenty-one years old and a student at the University of Oklahoma, was examined at the Mayo Clinic in February, 1936. For three or four years she had had headaches involving the occipital and frontal areas which had gradually increased in frequency until they occurred almost every day. The year previous to examination she had tired easily, had dyspnea with exertion, episodes of dizziness, nocturia two to three times and transient pains in the left thorax occurring during rest and exercise. Insomnia had been present for seven months. Three months before examination at the Clinic, examination for fitness for athletics at the University disclosed severe hypertension. The physical examination was essentially negative except for hypertension, slight thickening of the radial arteries, and moderate narrowing and spasm of the retinal arteries

FIG. 14. A slide made from running text

REPORT OF CASE 18

History and physical examination
Woman, 21 yrs. old, student, examined at Mayo Clinic Feb. 1936
For 3 or 4 yrs. before exam.: occipital and frontal ache; increased in frequency to almost every day
For 1 yr. before exam.: fatigue, dyspnea on exertion, dizziness, nocturia, transient pain left thorax during rest or exercise
For 7 mo. before exam.: insomnia 3 mo. before exam.: severe hypertension discovered elsewhere
Exam. at clinic: hypertension, slight thickening radial arteries, moderate narrowing and spasm of retinal arteries

FIG. 15. The slide that was constructed from the material represented in figure 14

assailing my ears with another set, I become confused. I gain more either by closing my eyes and listening or by stopping my ears and reading. As for the speaker who turns his back to the audience, in the dark, and traces with his pointer the very words that are on the screen, reading

them aloud meanwhile, I do not like his presentation at all. Perhaps these are personal foibles. Nevertheless, I do feel that in many cases in which slides are used the presentation would be more arresting if the

History:
A man, 34 years old, examined in January 1936
Hypertension known three years, gradual increase in blood pressure, headache and fatigue
Examination:
Blood pressure:
Range: Systolic 214 to 145
Diastolic 140 to 100
Mean: Systolic 170; diastolic 120
Cold test: Systolic 218 diastolic 150
Transverse diameter of heart 14.5 cm., chest 30 cm., inverted T waves in leads I and II
Kidneys: albuminuria grade 2; blood urea 28
Ocular fundi: arteries narrowed grade 1; sclerosed grade 2; retinitis
Operations: January 22, 1936 and February 12, 1936
Two stage, bilateral resection of the splanchnic nerves, the first and second lumbar ganglions and parts of the celiac ganglions and parts of the suprarenal glands
Reexamined June 2 1936, four months after operation
Blood pressure:
Range: Systolic 114 to 110
Diastolic 80 to 80
Mean: Systolic 112; diastolic 80
Cold test: Systolic 160; diastolic 120
Transverse diameter of heart 12.5 cm., chest 28 cm., no inversion of T waves
Kidneys: no albuminuria; urea 28
Ocular fundi: arteries narrowed grade 1; sclerosed grade 1; no retinitis
Follow-up letter September 15, 1936, seven months after operation
Blood pressure: 135/100, 130/98, 130/102
General strength 60 per cent of normal, no headache, dyspnea grade 1

FIG. 16. A slide of thirty-five lines which, although in the form of an outline, is susceptible of improvement.

Man, 34 years, examined Jan., 1936. Hypertension known three years. Gradual increase blood pressure. Headache and fatigue
Blood pressure: range 214/140 to 145/100; mean 170/120; cold test 218/158. Thorax: diameter of chest 30 cm.; of heart 14.5 cm. Inverted T waves in leads I and II Kidneys: albuminuria grade 2; blood urea 28 Retinae: arteries narrowed grade 1; sclerosed grade 2; retinitis
Operations: Jan. 22 and Feb. 12. Extensive sympathectomy (Adson technic)
Reexamination four months after operation Blood pressure: range 114/80 to 110/80; mean 112/80; cold test 160/120 Thorax: diameter chest 28 cm.; heart 12.5 cm. No inverted T waves Kidneys: no albuminuria; urea 28 Retinae: arteries narrowed grade 1; sclerosed grade 1; no retinitis
Follow-up letter; seven months after operation Blood pressure: 135/100; 130/98; 130/102 General: Strength 60 per cent of normal; no headache; dyspnea grade 1

FIG. 17. The slide that was constructed from the material represented in figure 16

speaker faced the audience, with the light on him, and either spoke to the faces of his hearers or read to their faces from sheets or cards.

I have drifted from my point of view a little, from a consideration of

planning of the copy to that of the speaker's method of delivery. Let me return to the former subject. Even when copy has been reduced to tabular form, it may be susceptible of improvement. The material which first was in the form shown in figure 16 became that shown in figure 17.

Moreover, it is necessary in planning copy for a slide to consider more than grammar, spelling, capital letters and arrangement. The slide should be easily understandable, and if on first draft it is not, it should be rephrased or rebuilt. Usually the speaker is an expert in his field; everything about which he intends to speak is so clear to him that he could easily forget the necessity of making every step of his thinking clear to his audience. If the speaker whose first draft of a slide is represented in figure 18 had allowed it to remain in that form, although the quantities

Operations for prolapsus uteri - 1920 to 1928
Parity Incidence

	Vaginal hysterectomy	Kocher operation	Watkins-Wertheim	Modified Gilliam	Intraperitoneal shortening of round ligaments
Nulliparae	- 17	4	0	10	5
Primiparae	- 59	18	5	11	5
Para II	- 95	15	11	21	12
Para III	-106	14	12	15	7
Para IV	- 83	10	5	6	3
Para V	- 57	5	14	4	1
Para VI	- 44	6	4	2	3
Para VII	- 33	4	2	1	0
Para VIII	- 27	1	1	0	0
Para IX	- 22	0	0	0	0
Para X	- 10	0	3	0	0
Para XI	- 11	1	1	0	0
Para XII	- 6	0	1	0	0
Para XIII	- 5	0	0	0	0
Para XIV	- 1	0	0	0	0
Average	- 4.41	3.22	4.27	2.68	2.74

FIG. 18. A slide of which, in the first draft, the caption and headings were misleading.

are correct, the caption and the headings would have been misleading. The purpose of the table was not primarily to record the number of the various operations performed for uterine prolapse in the designated interval but to give the record of childbearing of the women who underwent the various operations. The caption of the table, therefore, was changed to read as it appears in figure 19. It will be interesting to make some further comparisons. In figure 18 the heading "parity incidence" appearing over the columns of figures would give the impression that certain women had borne an incredible number of children. These figures represent, however (fig. 19), the number of women who underwent the various operations. The left-hand column of figure 18 was susceptible of improvement (fig. 19). And now, only once more to return to figure 18: It is evident the row of quantities designated as

averages are not averages of the respective columns. These quantities (fig. 19) represent the average number of children per woman, nulliparae, of course, excluded from the calculation.

In the table just shown, the arithmetic was correct, as I said, but a speaker cannot be too careful to avoid arithmetical errors. As all readers and authors of medical articles know, such errors will creep in. Errors may occur in the original calculations and may be repeated through second and third calculations made for the purpose of verification. They may be slips of the pencil or typographic errors. They may be trivial but, also, they can be serious. Every speaker I think,

RECORD OF CHILD-BEARING OF WOMEN WHO UNDERWENT OPERATION FOR PROLAPSE OF THE UTERUS, 1920 TO 1928

	Women who underwent various operations				
Children born	Vaginal hysterectomy	Kocher operation	Watkins-Wertheim	Modified Gilliam	Intraperitoneal shortening of round ligaments
None	17	4	0	10	5
1	59	18	5	11	5
2	95	15	11	21	12
3	106	14	12	15	7
4	83	10	5	6	3
5	57	5	14	4	1
6	44	6	4	2	3
7	33	4	2	1	0
8	27	1	1	0	0
9	22	0	0	0	0
10	10	0	3	0	0
11	11	1	1	0	0
12	6	0	1	0	0
13	5	0	0	0	0
14	1	0	0	0	0
Total	576	78	59	70	36
Average*	4.41	3.22	4.27	2.68	2.74

*Average number of children per woman, nulliparae excluded from calculation

FIG. 19. The slide that was constructed from the material represented in figure 18

after his paper and the copy for his slides have been typed and supposedly verified, should go to bed and then, on a new day, repeat all of his arithmetic.

CHANGING METHODS IN THE MANUFACTURE OF SLIDES

I have said nothing of the slide typed directly on cellophane, eliminating photography, or of the slide made with white characters on a black background. This latter type of slide was tried at the Clinic, but the staff did not like it. Newer methods of color photography allow certain quantities on tabular and textual slides to be picked out in red. This is meeting with some favor. And last, there is evidence that for use under

certain conditions glass lantern slides may give way to the small slide composed of a section of 35 mm. film, set in a cardboard mount measuring 2 by 2 inches. One of the manufacturers of such slides states that seventy-five of these slides, in a wooden case, weigh only three-fourths pound. The slides are unbreakable and cheap. The projector is so inexpensive that a speaker can own one, and it is so small that to carry it is no burden. I procured from Dr. Alvarez the address of this manufacturer[3] and the sample which he sent me fell on the floor when I opened the envelope. That in itself was a good demonstration, for the slide was uninjured.

These are interesting matters but I think I have written enough; perhaps too much.

[3] E. W. Fick, 2121 Main Street, Davenport, Iowa.

THE PHOTOGRAPHY OF GLASS APPARATUS*†

LOUIS SCHMIDT AND JOSEPH B. HAULENBEEK

New York

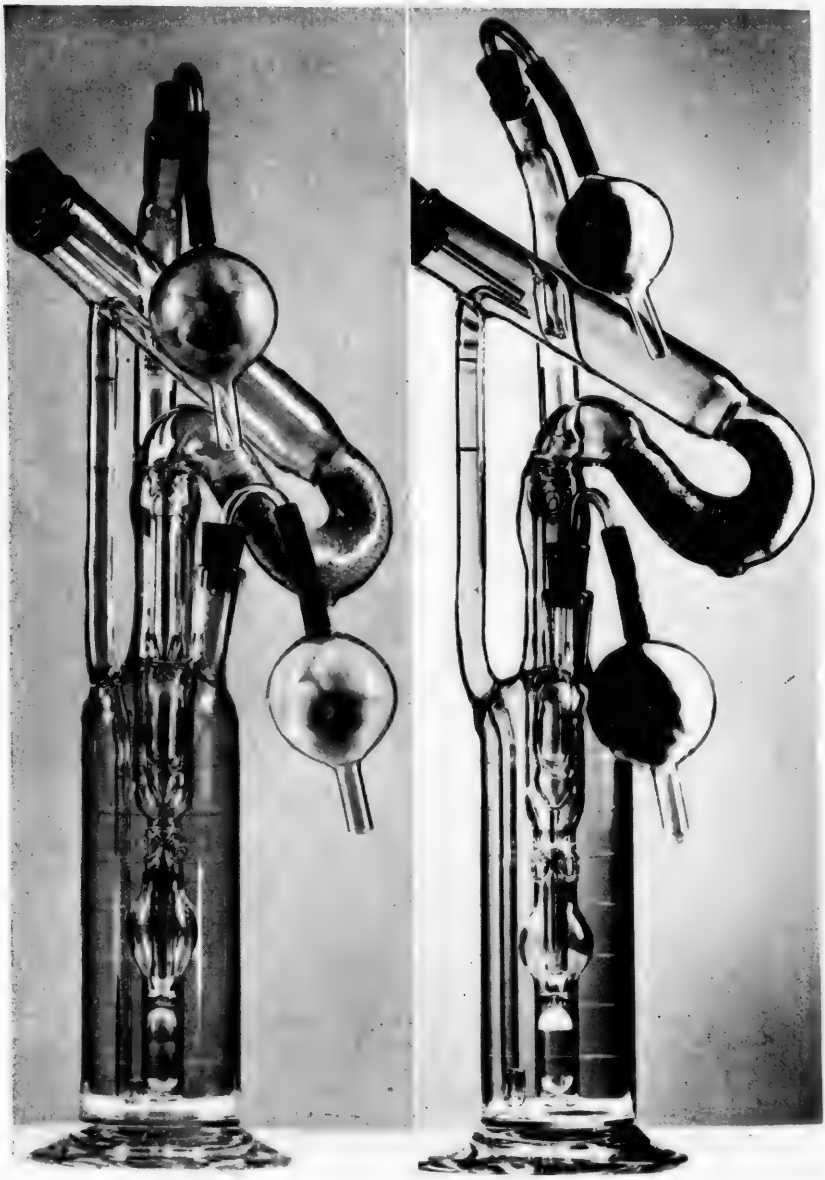
Most biological photographers are sometimes required to photograph apparatus composed of glass, metal or both. We think this justifies us in presenting the problem, pointing out the difficulties, describing our methods and showing some of our progressive results and the final solution.

Intricate glass apparatus, because it is composed of many parts, some placed one within the other, is very difficult to photograph. This is due to the fact that all of the component parts pick up high lights and reflect them on other parts, sometimes obscuring important details of the inner structures. The difficulties increase in proportion to the number of units that are placed within each other.

This accounts for the fact that such subjects are usually presented in publications by means of more or less diagrammatic drawings. They have often been regarded as subjects that were unsuited to photographic rendition.

Our subject, The Lindbergh Perfusion Pump, developed in collabora-

* From the Illustration Division, The Rockefeller Institute for Medical Research.
† Received for publication December 1, 1936.



A *B*

tion with Dr. Alexis Carrel, is very complex in design and therefore a difficult problem to photograph. In some parts the subject is an assembly of five glass structures, one within the other.

C

It was at once realized that front lighting would produce too many high lights and that a good deal of experimental study was indicated. With all our early trials the main faults lie in broad high lights on

both outer and inner units and tubes and the lower part of the main cylinder. These more or less obscured important details.

In *A* the spheres containing cotton wool and the U tube containing crystals are shown in their correct values. In fact, they show to better advantage here than in any of our pictures, but these are quite unimportant parts of the apparatus. The essential units are very much obscured by meaningless and disturbing reflections. The result is a picture giving a fair idea of the assembly and showing some nonessential parts very well, but it is quite useless in conveying information as to the details of the inner structures. In the lower part of the cylinder the inner units are hidden by a broad reflection. This also applies to the parts inside the cylinder, its neck, and the tubes coming out of its top. The illumination was obtained by means of two Cooper-Hewitt U tubes placed on either side and a few inches behind the subject, and directed equally from both sides at about the level with the top. The background was a pale wall about four feet distant. Several changes in lighting were tried. In our third picture *B* the light unit on the left was directed toward the wall. The pose was unintentionally changed somewhat.

The result is slightly different and improved in certain ways, especially in showing the contents of the cylinder. The technic was again modified without much gain in quality. Commercial Ortho film was used for the first four negatives.

Having met with poor results thus far it was decided to resort to back lighting with a black background. This technic had previously given good results in the photography of obscure growths in liquid media and with precipitation tests in tubes. The result is shown in *C*, our fifth and final effort. A few reflections persist in the curved neck of the cylinder and in the diagonal tube at the top. With these exceptions every white line, both superficial and deep, conveys the nature of the various parts. Each separate structure may be clearly seen. A number of parts are demonstrated that were not visible in any of our other photographs. Note the distinctness of all the units in the cylinder; the absence of the bright reflection at its base; the clearness of the tubes within the tubes in the neck and within the tubes above and behind the neck.

The spheres and U tubes convey the nature of their contents in spite of the fact that they are in deep shadow. There is no doubt that this

is glassware, although practically all of the disturbing reflections have been eliminated.

Technic: The pump was placed on a stand covered with black cardboard. It was nine inches in front of a window on the level of the sill. Behind the subject and against the glass was placed a piece of black cardboard 15 x 18 inches in size. Diffuse daylight falling over and around this cardboard was the only light that illuminated the apparatus, excepting the negligible amount reflected from the walls of the room.

As the subject was an extremely contrasty one, Eastman Process film was used.

If the black rubber stoppers and tubing had been replaced with white rubber, the resulting photographs would have been better. If red rubber had been used, we would have employed Panchromatic films and a red filter.

PRINT QUALITY*†

RALPH P. CREER

Hines, Illinois

The purpose of this paper is to stimulate a keener interest in the quality of photographic illustrations in medicine and to discuss briefly a few of the factors which may help us to improve the technical quality of our prints. This subject has been touched upon from time to time by Mr. F. R. Harding in his column "Photographic Technique, New Processes and Equipment." However, I do feel that the average medical photographer does not place enough emphasis on this phase of his work, and as a result there is too often a definite lack of brilliancy in his finished prints.

During the past two years I have been in contact to some extent with a few high grade commercial illustrators. It was interesting to observe the clean-cut, sharp, crisp quality which they were able to put into their pictures. The problem is, of course, purely a technical one, and many of the considerations involved in this article may be applied to other branches of photography as well as clinical photography. A good deal of the ground to be covered must be familiar to everyone here; however, a

* From the Tumor Research Unit Veterans Administration.

† Read at the 1936 Convention of the Biological Photographic Association.

little stocktaking in the obvious and even in the elementary may often be done with advantage.

While this article was in the making, it was suggested that the introduction include a definition of print quality. It is very difficult to reduce to simple terms the intangibles of the photograph which we call quality and distinction. However, in reading over the literature on the subject I found the following description of the meaning of the term.

1. The satisfactory rendering of the tone values of the subject.—Boucher: *Amer. Annual Photo.*, 1936.
2. The art of producing those black and white tones in the print which will most nearly represent the intrinsic brightness of the colors in the subject.—Boucher: *Amer. Annual Photo.*, 1936.
3. The relation existing between the many-hued brightness values of the subject and the corresponding tone values in the photograph.—Boucher: *Amer. Annual Photo.*, 1936.
4. In technical terms the perfect negative is one which will reproduce correctly, through the medium of reduced silver salts, a series of opacities proportional to the various degrees of subject brightness.—Boucher: *Amer. Annual Photo.*, 1936.
5. A truthful representation of the subject to the eye.—Boucher: *Amer. Annual Photo.*, 1936.
6. That which makes one print stand out among many.

Let us consider for a few moments some of the factors which affect print quality. One of the most important contributions to a successful clinical picture is correct lighting of the subject. In this brief discussion of lighting I shall confine my remarks to pathological specimens and photographs of patients.

It has been my observation that clinical photographers, especially beginners in the profession, are prone to adopt a more or less standard or fixed form of lighting for all cases. Patients are generally lighted with two 500 watt lights placed on either side of the camera at equal distances from the subject. Gross specimens are usually lighted by one fixed source of light together with a reflector placed opposite the light. Many of our subjects are quite different from each other and in my opinion the lighting should vary according to the individual characteristics of the subject. A specimen may be lighted so that it appears very flat and uninteresting or the lights may be arranged so as to give the subject snap and contrast and at the same time bring out the finer details.

In most cases, the details or *texture* of superficial lesions of the skin

will be brought out much more distinctly if crosslighting is employed. Crosslighting may be produced by placing one floodlight at about a twenty degree angle to the subject and a reflector opposite the light so as to lighten the shadows to the desired degree. This same lighting effect may also be obtained by placing a spotlight at about a ten degree angle to the subject and pointing the flood or "filler-light" directly at the subject. Of course, these lights should be arranged so that the spotlight predominates. Under this type of lighting such lesions as psoriasis, melanomas, etc., will not only stand out much more clearly from the normal tissues, but the textural details of the condition itself will be made a good deal more distinct.

In the December, 1933 issue of our Journal there appeared an editorial entitled "The Proper Lighting of Pathological Specimens." In this article the author recommended a standard type of lighting called "upper left-hand corner lighting." A fixed lighting arrangement may prove satisfactory in many cases. There are many instances where crosslighting to some degree will produce a more satisfactory gross picture. This is particularly true of flat specimens such as a cross section of a spleen, liver, or bone, and in the case of a lung where the surface texture is to be an important part of the picture.

Mr. Harding has already discussed lateral illumination for the purpose of accentuating small cysts or tumor areas in cases where there is a bulging of the skin.

Whenever light is directed at an angle to the camera there is always the possibility of scattered rays entering the lens, thereby producing a slightly fogged film. Regardless of the type of lights or their arrangement, it is wise to use a lens hood at all times. I have made a series of photographs with and without a lens hood, and after carefully studying the final results I found that those taken with the hood are superior in quality.

I shall make no attempt in this paper to go into a technical discussion of the choice of lenses for our type of work. If one were to visit twenty-five clinical photographic departments, I am quite sure he would find twenty-five different lenses being used to photograph patients and gross specimens. Nevertheless, their results might be very much the same. Suffice it to say that, whatever the choice of lenses they should be carefully cleaned at definite periods if the very best results are to be expected.

Lack of chemical quality is another reason for poor pictures. In this

connection the importance of cleanliness in the dark room cannot be sufficiently stressed. How often do you clean your developing trays? Are your developing and fixing tanks really *scrubbed* each time the solutions are changed? Do you keep your negative developer freshly mixed or do you try to run through a few more batches of films after the solution has been overworked and become stale? Old developer will produce a slightly fogged film and as a result the printing value of your negatives will be lost. Temperature control is most important in developing and fixing baths, and in the mixing of the chemicals that make up these two solutions. From a developing standpoint too high temperature produces a foggy negative. Photographic solutions should be mixed at a temperature of about 125° Fahrenheit and should never be used until they have cooled down to a temperature of 65° Fahrenheit for developing negatives and 70° Fahrenheit for prints. How long has it been since your entire darkroom was thoroughly cleaned? Do you mix your solutions in the same room that your developing is done? Hypo and other chemical dust in the air will contribute much to poor print quality. Do you accidentally carry small quantities of hypo into the developer while printing? Check up and see if there are any light leaks in your enlarging machine or camera. Are the safe lights in the enlarger and on the darkroom walls safe for the paper you are now using? These may seem like small items, but unless we give them some attention our final results will always be lacking in print quality.

We must bear in mind that the negative is the foundation of the picture and no amount of work can make up for a poor one. Correct exposure time and development cannot be overemphasized. A negative should be so exposed and developed that it records the full tonal scale of the original subject. This quality is lost in a dense negative. It is only when the original negative appears more or less clear and transparent, that a true representation of the original can be made. Too often we rely upon the latitude of our film. How many people conscientiously show a long line of negatives made from a wide range of exposures on a single subject with corresponding prints pretty well alike! This is the latitude we presume upon but in the last analysis there is only one correct exposure.

A thin layer of scum over the surface of the finished print is often due to dirty ferrotype tins. This can easily be avoided by keeping your tins well cleaned and polished.

During our last convention Mr. Karth of the Jahn and Ollier Publishing and Engraving Company stated that, as a general rule, prints of slight contrast reproduce better than normal or flat prints. Of course, there are certain exceptions to this rule. However, this suggestion should be borne in mind whenever we are preparing illustrations for publication purposes. In general, we should strive to produce pictures which have rich shadows and clear high lights. I believe that we, as medical photographers, have much to learn from our colleagues in the commercial illustrating field, especially insofar as print quality is concerned.

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PRINT CRITICISM

PHOTOMICROGRAPHY OF LEUCOCYTES*

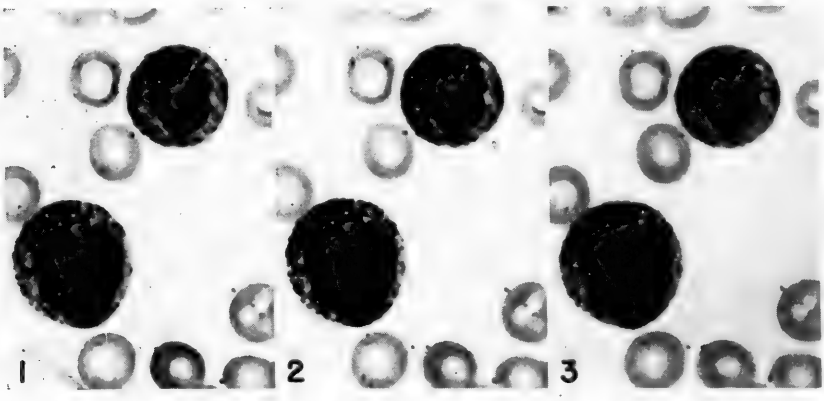
JEAN KIEFFER

Norwich, Conn.

The selection of proper filters is essential for the satisfactory photomicrographic reproduction of leucocytes.

Small variations in shade have to be reproduced, both in the palely stained cytoplasm as well as in the darkly stained nuclei. Very minute differences in the color of filters often have a marked effect on the result, and each specimen must be treated individually. The usual variations in the blood stains sent in for photomicrography preclude the use of a standardized technic except on very broad general principles.

The accompanying photomicrographs were made on an average Wright's stain. The negative for Print 1 was taken on Eastman Commercial Panchromatic film,



through an "X 1" filter; the negative for Print 2 was taken on the same material but through "B" plus "G" filters, correcting the exposure so that approximately equal densities were obtained. Both prints are on the same grade of paper, Haloid Nomis F2. It is to be noticed that the red cells in both are of the same density and general appearance, but that the good detail visible in the darkly stained nuclei in Print 1 is practically all lost in Print 2. Changing the printing technic in Print 2 by the use of a softer grade of paper (Nomis F1) brings out a small amount of detail in the nuclei, but at the same time it changes the relations of the other structures so that the picture as a whole has a muddy appearance and is far from satisfactory. (Print 3.)

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* From the Norwich State Tuberculosis Sanatorium.

It is not implied here that the "X 1" filter with commercial panchromatic film is the best combination for all types of blood work, nor that the "B" plus "G" combination should not be used. These prints are made to show how a small difference in the filter will change the color. Visually there is little difference in color between the two combinations, although the "X 1" is paler. When photographing pale specimens the "B" plus "G" combination should prove best. A "B" filter alone would give results approximately between Print 1 and Print 2, and is often useful. The proper choice of filter also depends on the color sensitivity of the negative material used and on the color quality of the illuminant.

The article on "The Photomicrography of Blood" by Stella Zimmer in the March, 1937 B. P. A. JOURNAL, page 113, is an excellent reference.

PHOTOGRAPHIC TECHNIC, NEW PROCESSES AND EQUIPMENT*†

F. R. HARDING

Boston, Mass.

RECORD KEEPING

There are almost as many systems of filing and record keeping as there are institutional photographic departments. Each institution has an individual problem that must be solved by the department. There is no single system that will work universally. The following system is employed at the Children's Hospital in Boston, where it has been found quite satisfactory.

When a photograph is desired the doctor ordering the photograph makes out a photographic requisition. These blanks are kept in all wards and in the Out Patient department. A telephone call is then made to the Department of Photography for an appointment. This appointment is made, as far as possible, at the time most convenient from the standpoint of the ward calling the Department. The patient is transported to the Department by an orderly accompanied by a nurse or attendant who brings the requisition. The nurse or attendant assists the photographer by holding or supporting the patient and also attends to the removal and replacement of clothing. After the negative has been exposed a photographic number is assigned to the case. This number is placed on the requisition and on the negative. If the patient is again sent to the Department at a later date, the same number is used with the addition of a letter, as 1234ABC, etc. After the negatives have been developed they are sorted and placed in negative envelopes. Most of the data that appears on the requisition also appears on the negative envelope. The same number is also placeP at the top right-hand corner of the envelope with a heavy black crayon. All envelopes

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* From the Department of Photography, Children's Hospital.

† Received for publication April 10, 1937.

Photo No....6789.....

Name Doe,John Age 4½y. Hospital No..807911.

Date

Diagnosis Hemangioma-lip 5-21-37

Views 2-A-A face-1 norm.-1 infra red

Ward 4 Referred by Dr.Roe M.D.

O. P. D. Dept. Surgical

FORM 226-2300-3-37

are filed by these numbers. At the same time a filing card is made out which contains all the data on the requisition, and these cards are filed according to the name of the patient. The file is also cross-indexed by diagnosis. A day book is kept which is written up at the end of each day. This book contains the patient's name, the number of negatives made, whether the case was "House" or "Out Patient," the department, the hospital record number and the photographic number. The book is of assistance in compiling the monthly report of Department activities. It is also of value in checking the card file for accuracy of record numbers, etc. After the prints are made, and only one set is made routinely, they are mounted on heavy gray paper. If the patient is still in the hospital the prints are sent to the ward and placed on the patient's hospital record. If the case was from "Out Patient" or has been discharged from the hospital, the photographic sheets are sent to the record library and filed with the clinical record. In a number of departments one interne is detailed to write on the photographic sheet the reason for taking the photograph and the points of interest demonstrated thereby. This is often valuable data. Photographic sheets of ward patients that have been discharged are never delivered to the ward as the sheets may be lost. They may always be seen by obtaining the patient's clinical record from the record library. The system that has been described is simple, for simplicity is desirable. Given the patient's name it is a matter of less than one minute to produce the negative. If the diagnosis alone is given, a card can be produced that will list all the patients having that particular diagnosis. All material, clinical and pathological, is filed by the same system. The photographic number is employed as the key in filing the negatives.

At the Harvard Dental School a radically different system is employed which gives complete satisfaction at that institution. The negatives are filed by name. After prints are made they are mounted in albums which are titled according to department and diagnosis, as, "Surgical Dept.—Epulis—Alveolectomy." Under each photograph is a card listing the patient's name, date and diagnosis. To find a negative by this system it is only necessary to go to the proper album, note the name of the patient, and secure the envelope from the negative file. The file is arranged alphabetically according to the name of the patient.

It will be seen from these two illustrations of working systems that the methods may vary greatly and yet be entirely adequate for their particular purpose.

PHOTOGRAPHY OF COLORED OBJECTS

It is possible for the biological photographer of today to accurately control the rendition of color in monochrome. The relative brightness of any color can be lowered or raised. All colors of a subject can be rendered in their correct monochrome values. A wide range of contrast can be produced between colors of equal monochrome value. A color can be made to reproduce either light or dark.

This broad control of results in photographing colors, so valuable in biological photography, is made possible by the use of panchromatic

materials and filters. Every photographer can broaden the scope and value of his work by learning how to use them.

Three main factors determine results when colors are photographed: first, the color sensitivity of the negative material that is employed; second, the absorption power of the filter used; third, the nature of the light under which the picture is being made.

For full control of results a film or plate must be used which is sensitive to all visible colors. Panchromatic materials meet this requirement. All panchromatic materials are not equally sensitive to different colors. They are usually classed in three groups: "A," the ordinary panchromatic materials, while sensitive to all colors, are especially sensitive to the violet end of the spectrum; "B," orthopanchromatic materials are slightly more sensitive to greens than to reds; "C," hyperpanchromatic materials are especially sensitive to the red end of the spectrum. In determining which filter is to be used the first consideration must be the particular sensitivity of the negative material. The second consideration should be the result it is desirable to produce on this material. For example, if an ordinary panchromatic film with its extreme blue sensitivity is being used and it is desired to render all colors in their correct monochrome values, a filter must be employed which will stop some of the blue rays and allow the other rays to come through. In this case a yellow filter will be used.

This choice of a filter for color correction may be determined by following the rule that objects appear colored because they absorb all the colors of the spectrum except their own, which they reflect. Yellow objects absorb blue light, therefore a yellow filter will be used to stop blue rays. In the same way, red objects absorb blue and green light, green objects absorb blue and red light, deep blue objects absorb blue and red light, magenta or purple objects absorb green light, and light blue or blue green objects absorb red light. For such color correction an orthochromatic filter is used. In the case of ordinary panchromatic materials with their extreme sensitivity to blues a yellow filter will be required to absorb some of the blue rays. When hyperpanchromatic materials with their extreme sensitivity to reds are used, a green filter to stop both the red and blue rays should be used. Where contrast is desired rather than correct rendering of monochrome values, a contrast filter is used. Colors of equal monochrome value may be given any degree of contrast. Great detail, such as the grain in colored woods, may be produced by using a

filter of the same color as the wood. Any color may be photographed as black by using a filter that completely absorbs the color.

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A NEW BINOCULAR MAGNIFYING LOUPE

A new binocular loupe, distinguished from all previous magnifiers by a unique design which allows it to be fitted to the individual wearer, will benefit a wide range of professions, occupations and industries, according to the laboratories of Bausch & Lomb Optical Co., in which it was designed.

Three-power magnifying lenses, providing stereoscopic vision, are mounted on the end of a bar extending out from the specially designed frame and bridge. A flip of the finger throws the magnifier up and out of the line of vision when desired. Even when worn constantly, however, comfort is assured by the method of construction, which permits the accurate fitting of the frame by changing bridge width and interpupillary distance for individual cases.

The loupe is essentially a spectacle frame with an ingenious aluminum block in place of a bridge. Round eyewires are mounted on slotted bars and held to the bridge block by a set screw. By loosening the set screw each eyewire can be adjusted separately to get the proper interpupillary distance for the wearer. The extra large pads are also mounted on the bridge block so that their separation may be adapted to the individual. Proper adjustments are made by competent fitters when the loupe is purchased.

When the user ordinarily wears correcting lenses these may be mounted in the eyewires and the proper adjustments made for bridge width and interpupillary distance or, if preferred, the loupe can be worn over regular glasses and the eyewires left blank. After the loupe is fitted the wearer can adjust the separation of the magnifying lenses to suit himself.

In the professions of surgery, dentistry, ophthalmology and other branches of medicine a three-dimensional magnified view of an object is often desired.

Association News

The Seventh Annual Convention of the Biological Photographic Association will take place in Rochester, New York, September 23, 24 and 25, 1937. The Hotel Rochester will be headquarters.

The advent of color into the specialized field of medical photography has provided a means whereby photographs can be obtained which not only demonstrate pathological destruction and alteration of tissue, but also show how the tissue actually appears to the eye. Since the medical profession is acutely interested in the application of color photography to medicine, medical photographers are being repeatedly asked whether or not they are equipped to do this type of work. As a consequence, the dominant theme of the program will be color photography. With that in view arrangements have been made for demonstrations of the leading color processes now in vogue. Members of the Association are encouraged to communicate with the Chairman of the Program Committee in the event that they have been engaged in any type of color photography, with a view toward presenting some of their experiences before the convention. Members are also encouraged to communicate with the Chairman, Mr. Payne, in the event that they contemplate preparing or have in the process of preparation other papers dealing with subject matter pertinent to the aims of this Association.

The following committees have been formed to handle all arrangements for the meeting:

Program Committee:

Mr. Wm. F. Payne, *Chairman*
State Institute for Study of Malignant Disease
113 High Street
Buffalo, New York
Miss Stella Zimmer
Mr. L. V. Foster
Dr. Oscar W. Richards
Mr. Arthur W. Fuchs

Salon Committee:

Mr. Leo C. Massopust, *Chairman*
Marquette Univ. School of Medicine
561 North 15th Street
Milwaukee, Wisconsin
Mr. L. A. Julin
Mr. Henry Morris
Mr. Frank N. Ruslander

All convention activities will be held in Hotel Rochester, where suitable arrangements have been completed for the salon and commercial exhibits. Since a large

meeting is expected the Hotel Powers will cooperate in providing sufficient accommodation for members who fail to make reservations at an early date at the Hotel Rochester. The rates quoted by the two hotels are as follows.

Hotel Rochester:

Room without bath, but located conveniently near a semiprivate bath			$2.25
Single room with private bath	$3.00	$3.50	4.00
Double room, double bed, private bath	4.50	5.00	6.00
Twin bedroom with private bath	5.00	6.00	7.00

Hotel Powers:

Single room with private bath	2.50	3.00	3.50
Double room with private bath	4.00	5.00	6.00

Members are urged to make reservations early so that adequate accommodations may be secured.

The following papers have been scheduled to date and others are now in process of preparation. It is expected that the program will be completely formed by August 1.

"Photomacrography." Mr. Louis Schmidt, Rockefeller Institute for Medical Research, New York City.

"Phantom Photographs." Mr. Ferdinand R. Harding, The Children's Hospital, Boston, Mass.

"Colored Light, Filters and Photography." Dr. Oscar W. Richards, Spencer Lens Company, Buffalo, New York.

"Photography in Criminology." Mr. Louis Waters, Syracuse, New York.

"An Illuminating System for Large Transparent Sections in Photomicrography." Mr. J. V. Butterfield, Bausch & Lomb Optical Co., Rochester, New York.

"Pola-Screens in Medical Photography." Mr. J. W. McFarlane, Eastman Kodak Company, Rochester, New York.

"Infra-Red Photography." Mr. Leo C. Massopust, Marquette Univ. School of Medicine, Milwaukee, Wisconsin.

"16 mm. Surgical Motion Pictures—Kodachrome and Black-and-White."

"Eastman Wash-Off Relief Process of Color Photography."

"The Reproduction of Kodachrome Photographs by Means of Eastman Wash-Off Relief Process—Prints and Transparencies."

Due to the facilities for hanging photographs in the Salon Exhibition, the Salon Committee has requested that all prints should be suitably and attractively mounted on white or buff-colored stock of medium thickness. All mounts should be either 12 x 16″ or 16 x 20″ in dimension. Where a series of prints illustrating one subject is to be shown, as many prints as convenient should be placed on one mount. All photographs should be thoroughly and concisely captioned so that visitors to the exhibition will understand clearly the exact nature of the subject that is being shown. Short descriptions of technic and lighting diagrams should be given wherever a particular technic of photography is being demonstrated. The name and address of the exhibitor must appear on the back of each mount; it should also appear in a suitable manner on the face of the mount.

Owing to the lack of facilities for an extensive showing of transparencies, it is requested that prints be submitted wherever possible.

All entries for the salon must be in the hands of the Salon Committee by September 1 so that adequate space may be secured for hanging the material. Please send all salon material, *prepaid*, to Mr. Arthur W. Fuchs, 343 State St., Rochester, N. Y. No salon entries will be accepted after the closing date. The Salon Committee reserves right to reproduce any of the exhibits in this *Journal* and to give permission for the publication elsewhere of individual views of the salon. Reasonable care will be taken of all entries submitted, but the committee will not be responsible for damage or loss. At a later date full details will be sent by mail to all members.

Due to the nature of the program time will not permit visiting the plants of the various photographic manufacturing companies in Rochester during the convention days. However, arrangements have been made for members of the Association arriving early to visit these plants on September 22, the day before the convention opens. All members who intend to arrive by the morning of September 22 and wish to visit the factories of the Eastman Kodak Company and the Bausch & Lomb Optical Company should communicate with Mr. Arthur W. Fuchs sufficiently in advance so that adequate arrangements may be made for them.

* * * *

We have recently learned that on April 14 Mr. Ralph P. Creer presented a paper before the Technical Section of the Chicago Camera Club regarding the subject, "Photography as Applied to Medicine." To be published in the July issue of the new magazine, Popular Photography, will be an article by Mr. Creer entitled "Clinical Photography."

* * * *

A number of members of the Biological Photographic Association submitted exhibit material to the First International Exhibit of Scientific and Applied Photography which was held in Rochester, New York, March 15–April 3, 1937. This exhibition was sponsored by the Rochester Technical Section of the Photographic Society of America. Over 10,000 persons visited the show during this three weeks' period. Hundreds of entries were on display covering the following subject matter: Color, astronomical and aerial photography, photomicrography, metallography, radiography and medical photography, documentary and high-speed photography, photography in physics and chemistry, spectrography, natural history and press photography.

The outstanding exhibits were in color photography, radiography, and medical photomicrography and photography. The medical subject matter was of extreme interest and many contributions were made by members of this Association. An excellent series of medical photographs in color was submitted by Mr. Frank N. Ruslander of Detroit, Mich., who has recently become a member of our Association. Mr. Ruslander's work deserves high commendation both from an artistic and technical standpoint. It is our hope that Mr. Ruslander will have additional material to show in the Salon at our convention in the fall.

* * * *

Mr. John M. Muir recently took over the photographic department at the American Oncologic Hospital, Philadelphia, Pa. We wish Mr. Muir every success in his new work.

Our Secretary, Miss Anne Shiras, reports to us the following interesting series of incidents:

Miss Amelia Alvey wrote from the Banting Institute in Toronto, Canada, requesting information concerning photographic equipment for use exclusively in the autopsy room. The Secretary sent out an S.O.S. to members who were pathologists or worked with pathologists in various institutions. The members promptly replied but, to a man, the answer came back "we have no special equipment for use in the autopsy room." Various methods were suggested for the photography of gross specimens (most of which have already appeared in our Journal), but when it came to photographs of the cadaver the answer invariably was, "I have very few calls for that kind of work. When such a picture is needed I take my camera and lights into the autopsy room and arrange them in the best way possible." A film of about the grade of portrait panchromatic was recommended in most cases. Photofloods were the favored lights, with one or two members holding out for Photoflash bulbs for greater convenience. A number of workers had advanced far enough to plan necessary equipment for this work in the event they were ever called upon for it. Many sketches of this equipment were sent to the Secretary. The sketches consisted of designs for various stands, some to be arranged at the same height as the autopsy table and serving as a vantage point for the photographer. Mr. Creer sent a plan of a heavy stand with an iron rod to which the camera could be attached, and which could be raised or lowered and moved in or out; he placed a mirror at a suitable angle with the ground glass so that a photographer standing below the camera could find the correct range. Mr. Sage sent an ingenious plan for keeping the camera horizontal and photographing a mirror which was adapted from a technic sometimes used in the operating room.

While these replies were being collected, Mr. Levin showed a series of pictures at a meeting of the Pittsburgh Chapter illustrating his first experiments in the autopsy room with Kodachrome film and a miniature camera. He used #1 Photofloods for head work and #2 for the body cavity; he kept his camera in the hand and gave from 1/40th to 1/60th of a second at f:3. His results were so good that his technic was sent in, along with all suggestions received, to Miss Alvey. She wrote a most appreciative letter in reply and explained that her work was entirely in the fields of pathology and bacteriology, and she wished to be prepared to take pictures in the autopsy room with a minimum of climbing onto tables and carrying equipment back and forth, especially as there was a storeroom convenient to the autopsy room in which special pieces of equipment could be kept. If any members have further suggestions she will undoubtedly be glad to hear from them. We suspect, however, that the shoe will be on the other foot and that we will be waiting for tips from Miss Alvey as to how she solved the problem.

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Mr. Don Wolfe, who is working at the U. S. Leprosy Investigation Station in Honolulu, writes:

"People here are actually photographically crazy, there being no end of movies and miniature cameras. Trending the technically-minded ones toward biological work would be comparatively easy, I believe, with a little stimulation.

"As for my own work, such as my spare time allows me, I am attempting infra-red

work on the skin lesions of lepers to try and determine the possibility of discovering tissue damage that may be otherwise undetectable. I hope to have data worth while within the space of a couple of months. . . . Photographic processing in this climate is no joke. Fungi grow between cemented lenses, and also find great delight in the various flavors of my colored filters."

* * * *

The Pittsburgh Chapter of the Biological Photographic Association met on March 3 for an evening on color work. The Department of Physics of the University cooperated by loaning equipment to show the primary colors in light and pigment, their complements and the effects of mixing colors; also a spectroscope for studying the spectrum of the various standard filters. Miss Shiras demonstrated this equipment with reference to color photography. Dr. Cohen followed with a series of slides made by the Agfa, Finlay and Dufay methods, showing the use of color in photomicrography. Kodachrome was presented by Mr. Albert Levin, with a series of pictures made in the autopsy room and in color copy work.

The last meeting of the season was held on May 5. Dr. Davenport Hooker presented the *Chairman's* address, "Scientific Pictures from an Editor's Point of View". Dr. Hooker is managing editor of the "Journal of Comparative Neurology." Mr. F. Ross Altwater, of the Altwater and Borther Photographic Company, spoke on "Projection Printing." Some of his prints were displayed on the Chapter's new print exhibit stand designed by *Vice Chairman* Chester O. Henry, which is built to fold up into two compact units in order to make transportation to lectures and exhibits easy. The Chapter feels that besides lantern slide demonstrations it is often important to exhibit large prints and transparencies, and that a suitable stand should be available to its members. If the stand passes the test of a thorough workout, it will be written up for the Journal.

Between these two regular meetings an informal gathering was held on April 21 at which Mr. Larson of the Westinghouse Company tested the shutter speeds of members' cameras with his special timing device. On the whole, shutters were found to be comparatively accurate in their medium speeds, but in several cases deviation increased in the fast and slow exposures. Thus, 1/200th sometimes was practically the same as 1/100th, and 1/10th the same as 1/20th. This last point might be a good one to remember the next time some fellow tries to make us envious by claiming he can consistently take good pictures in the hand at 1/10th of a second. Perhaps if the truth were known it would be found that he is giving closer to 1/25th.

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Our member, Mr. Jean Kieffer of the Norwich State Tuberculosis Sanatorium, has been in the limelight lately in print and on the air by virtue of his invention for radiography called "laminagraphy." See X-ray journals for the technical details, but in principle the laminagraph radiographically sections the body, focusing on the desired area and blotting our the planes around it, in other words, photographing suspected organs one slice at a time. We wish to congratulate Mr. Kieffer on this advance in X-ray work.

We wish to welcome the following new members. We hope they will find it possible to attend the fall meeting of the Association:

Samuel A. Crookes, M.D., College of Medical Evangelists, Loma Linda, Calif.
Frank N. Ruslander, Harper Hospital, Detroit, Mich.
George Shanks, M.D., Pathological Laboratory, Toronto Western Hospital, Toronto, Ont., Canada
Robert Raymond Sharp, School for the Feeble-Minded, Wrentham, Mass.
Marion E. Stouffer, South Bend Laboratory, South Bend, Ind.
Russell Lee Walp, Department of Biology, Marietta College, Marietta, Ohio

Other entering members have taken their membership as of next year, as the present membership year is nearly over. Their names will be published in the September number.

Arthur W. Fuchs
343 State Street
Rochester, N. Y.

REPORT OF THE COMMITTEE ON MOTION PICTURES

I. REGISTRATION OF FILMS FOR TEACHING

The American Council of Education, 744 Jackson Place, Washington, D. C., is cooperating with the United States Office of Education in the formation of a file listing all motion pictures which may be used in education. This includes technical films suitable for medical schools, etc. All members of the Association are urged to send to the Council for registration forms and to return them properly filled in to the Council. This file will be of service in many ways and they desire to list the type of films made by members of our Association.

II. SOURCES OF FILMS AND EQUIPMENT

The following comprehensive lists are revised frequently and eliminate the publication of sources as published in the June, 1935 issue of our JOURNAL.

Motion Pictures of the World. International Educational Pictures, Inc., 40 Mt. Vernon St., Boston, Mass. (50¢ a year, 2 issues.)

Medical Films and their Sources, Bell and Howell Co., 1801 Larchmont Ave., Chicago, Ill.

1000 and One. Blue Book of Nontheatrical Films. Educational Screen, 64 East Lake Place, Chicago, Ill. (75¢.)

Sources of educational films and equipment by C. M. Koon. From Editorial Division, U. S. Office of Education, Washington, D. C. 1936. 20 pp.

(This Government bulletin should be obtained by each member, because it gives other information about societies, indexes, books, etc., which will be useful to members either making or using motion pictures.)

Where to buy, rent and borrow 16 mm. films. 1936. 5th ed. 100 pp. Victor Animatograph Corp., Davenport, Iowa.

III. FILMS REPORTED BY MEMBERS OF THE ASSOCIATION

The following films have been reported and this list is an addition to the one published in the March, 1935 JOURNAL. The reports do not always indicate whether or not the films are available for loan or rental. Some of the films have been made by a member for a client and the availability then depends on the owner of the films. Those marked with an asterisk (*) are available. For the others it will be necessary to write to the member for information. Films not available are marked †.

Bernadine, Sister M., 9850 Falcon St., Hamtramck, Mich. †Clinical films of pathological specimens.

Bosse, K.K., N. Y. Post Graduate Hospital, 301 East 20th St., New York City. Functional activity of the gall bladder, normal and abnormal.

Cohen, Dr. Milton, 100 W. 59th St., New York City. *Porcelain jacket crowns, porcelain inlays and bridge restorations.

Foord, Dr. A. G., Huntington Memorial Hospital, Pasadena, Cal. Diagnosis of disease by laboratory methods.

Foust, H. L., Veterinary Anatomy, Iowa State College, Ames, Iowa. †Ovulation. †Cancer cells.

Gerry, Eloise, U. S. Forest Products Laboratory, Madison, Wis. Wood wisdom. (*From the U. S. Dept. of Agriculture, Washington, D. C.)

Hooker, Davenport, University of Pittsburgh, Pittsburgh, Pa. †Foetal movements. Eastman anatomical films (with Miss Anne Shiras).

Kieffer, Jean, Norwich State Tuberculosis Sanatorium, Norwich, Conn. Thoracoplasty. Extrapleural pneumolysis. Phrenectomy. Applying a cast to a tuberculous spine.

Kramer, Theodore C., Department of Anatomy, University of Michigan Medical School, Ann Arbor, Mich. Ovulation in the rabbit. Nesting habits and development of the Siamese fighting fish (*Betta splendens*). Development of *Amblystoma punctatum*.

Leon, Maxwell J., 121 Amboy St., Brooklyn, N. Y. †Records.

Proetz, Dr. Arthur W., Beaumont Medical Bldg., St. Louis, Mo. †Four films on nasal physiology and treatment.

Roger, Henry, Rolab, Sandy Hook, Conn. Colloids. Ferromagnetic iron oxide. Relief of prostatic obstruction by electrosurgery. For sale only.

Sage, Robert A., Pathological Department, Iowa Methodist Hospital, Des Moines, Iowa. The technique of post mortem examination.

Schanzenbach, William, 810 Grand Concourse, New York City. In the dough. Enzymes in dough fermentation. The story of a loaf of bread. The story of frozen eggs. (*From Standard Brands, Inc., Mr. R. W. Brooks, 595 Madison Ave., New York, N. Y.)

Spaulding, Milo H., Montana State College, Bozeman, Mont. †Bird studies.

The first report of the use of eight mm. films comes from Dr. L. W. R. Jackson, Botanical Laboratory, 38th and Woodland Ave., Philadelphia. His films are not available, but are being used in his lectures and field work. This small film will undoubtedly prove satisfactory for many purposes and requires a considerably smaller financial investment.

Several members report that they are making films but that the films are for others and therefore not available. It would be helpful if the titles of these films could be listed to show the kinds of work being done. It is sometimes possible for members concerned with similar subjects to obtain the films from the owners, even when they are not generally available.

The reports show a continuing increased use of motion picture films in both teaching and research.

K. K. Bosse
Jean Kieffer
Oscar W. Richards, *Chairman*